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SOME CURIOSITIES OF THINKING.*

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IT is evident to any one who has kept abreast with the recent progress in psychology that the advance in the knowledge of mental processes has been greatly aided of late by contributions from certain collateral branches of science. The older method of introspection had, indeed, resulted in establishing many facts and in formulating numerous laws of psychical action. But this method had many defects, and it must be admitted by any candid observer that the debt which psychology owes to more modern methods of research is a deep and lasting one. To these methods also we owe much of our present knowledge of what may be termed the mechanism of thinking.

It may not be without interest, therefore, to review some of the results which modern studies have reached, especially as such a review will bring before us some entertaining curiosities of thinking.

And, first, we must mention the remarkable discoveries in regard to the localization of brain functions which may be traced to physiological experimentation upon the lower animals. It was long ago determined by Fritsch and Hitzig, Ferrier, Munk, and Beevor and Horsley that in the lower animals certain districts upon the surface of the brain could be laid down, to each of which a definite sensory or motor function could be assigned. Within the past decade it has been absolutely proved by pathologists,

* Read before the Philosophical Club of Princeton.

among whom Charcot, Nothnagel, and Ferrier must be named, that the same statement may be made with regard to the brain of man. To-day a practical application is being constantly made in our hospitals of these important discoveries. For they not only enable us to determine the position of disease in the brain, but also afford a guide to the surgeon, who can cut through an apparently healthy head and skull and remove the diseased tissue. The results of brain surgery form one of the triumphs of medical science of which physiologists may justly take the credit. It is now well determined that from the eye, or from the ear, or from the skin definite nerve tracts can be traced to special regions of the brain. It is well known that all impressions received by the eye, or ear, or skin set up impulses which traverse these tracts and reach these special areas of the brain surface or cortex. When an impulse reaches the cortex a conscious perception is produced, and of this perception a definite memory remains, which memory is necessarily connected with the brain cells in the special area primarily excited. If disease destroys a sensory area, perceptions are no longer possible in the sensory organ to which it belongs, and memories stored up in that area are permanently lost. From this loss of particular perceptive power and of memories it is possible to determine the position of disease in the brain so exactly that it has been found feasible and justifiable to proceed to the removal of the disease, such as a clot or tumor, producing the symptoms.

It would afford material for an entire paper to study defects of memory and to describe some of the curiosities of thinking which result from such defects. A few examples may be related.

I saw lately a business man of keen mind and good general memory, who was not paralyzed in any way, and was perfectly able to understand and to talk, but who had suddenly lost a part of his power of reading and of mathematical calculation. The letters *d*, *g*, *q*, *x*, and *y*, though seen perfectly, were no longer recognized, and conveyed no more idea to him than Chinese characacters would to us. He had great difficulty in reading—had to spell out all words, and could not read words containing three letters. He could write the letters which he could read, but could not write the five letters mentioned. He could read and write some numbers, but 6, 7, and 8 had been lost to him; and when asked to write them his only result, after many attempts, was to begin to write the word six, seven, or eight, not being able to finish these, as the first and last contained letters (*x* and *g*) which he did not know. He could not add 7 and 5 together, or any two numbers of which 6, 7, or 8 formed a part, for he could not call them to his mind. Other numbers he knew well. He could no longer tell time by the watch. For a week after the onset of the

disease he did not recognize his surroundings. On going out for the first time the streets of the city no longer seemed familiar; on coming back he did not know his own house. After a few weeks, however, all his memories had returned excepting those of the letters and figures named; but as the loss of these put a stop to his reading and to all his business life, the small defect of memory was for him a serious thing. Experience has shown that such a defect is due to a small area of disease in one part of the brain. Such cases are not uncommon, and illustrate the separateness of our various memories and their dependence upon a sound brain.

Among the curiosities of thought which the physician meets with, unexpected perceptions suddenly appearing before the mind with the same vividness as ordinary perceptions, but without any accompanying external excitant, are not uncommon. A person may look at an empty chair and yet see a familiar form seated in that chair, and may even hear remarks made by this imaginary figure and not doubt for a moment that the figure is an actual entity.

I have seen persons talking with such imaginary individuals, and have had them assure me that they were as sure of their presence and of their voices as they were of my own. I have seen persons manifest the greatest alarm at the presence of animals about them, and refuse to believe from assurance that those animals were not there.

A young woman, having once been frightened by the sudden presentation to her of a white mouse, has been troubled for years by seeing this mouse running about her, upon her clothing, upon anything she is handling, and even upon her food; and, as a result, she is in a state of constant agitation and perplexity, though at times convinced that this is the product of her mind. She washes her hands and her clothing frequently because she is convinced that this animal has made them dirty; and she can not divest herself of the belief that it is real.

I have sometimes been able to convince persons that such fancied figures were not real by asking them to push one eyeball up a little with the finger. This makes all objects about them seem double, as any one can prove to himself, but it does not double the false image—the product of the mind. The young woman just mentioned was much comforted by this device.

Argument alone does not suffice in such a condition to convince one that an impression is erroneous. Thus, a woman who had gradually become totally blind, and was willing to admit that she could see nothing whatever, could not be convinced that she was not surrounded constantly by multitudes of little gnomelike pygmies, whom, she persistently declared, she *saw* before her, and whom she was afraid that she would step upon or crush by any

movement of her body. Yet she was blind. And when these false perceptions occur in the domain of hearing, either taking the form of definite commands, such as "You shall not eat," "You can not move," "You are a lost soul," or such a terrible order as "You must cut your throat," the impression which is produced may be so intense as to dominate the mind and hamper all mental action; and if these commands are not recognized as products of internal disease, they may lead to actions, such as suicide or homicide, which a sound judgment would condemn.

Our knowledge of the localization of brain functions, so far as sensory impressions are concerned, has enabled us to explain not only defects of perception and of memory, but also these false perceptions which we term hallucinations. It has made it evident that such hallucinations are the result of irritative disease in the definite region of the surface of the brain in which the memory pictures were stored. Disease excites the cortical cell to activity. The mental result is a perception which consciousness has no means of distinguishing from an actual perception, and which in a diseased state it regards as real.

The localization of motor functions is no less precise than that of the sensory functions. Every movement of a voluntary character, from the coarse act of grasping an object to the fine touch of the pianist, or the delicate stroke of the artist, or the graceful balancing and light movements of the dancer, originates in a well-defined portion of the brain surface. Destroy this portion of the surface and no amount of volition will produce the desired act; or let this portion be irritated by disease and, without the will, the act will be performed over and over again in an automatic manner and apparently without purpose.

The mechanism of speech has also been determined by these investigations into the localization of brain functions. We know that the understanding of words when spoken or when seen in print, and the articulation of words in speech or their production in writing, are all dependent upon the integrity of definite regions upon the brain surface. So positive are we of this that in certain cases, when either the comprehension of language is suddenly suspended by disease or the power of utterance of language is hampered by disease, we can put our finger upon the spot in the brain which is affected; and if that spot is pressed upon by a clot of blood or by a new growth, we can remove it and thus restore the power of understanding speech or the power of utterance. Dr. McBurney has reported * the case of a physician whose speech was thus restored after three months of silence by the removal of a clot from the motor speech center.

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* Brain, 1891, p. 284.

It is thus evident that research in experimental physiology has had an extent and an application to human psychology which were hardly dreamed of by the original investigators twenty years ago; and it is clear that as, little by little, the facts to which I have just alluded have been established, they have been seen to throw much light upon psychological processes, and to make our knowledge of the mechanism of thinking both wider and more precise.

Secondly: There is another field of investigation from which rich results for mental science have recently been reaped—namely, physiological psychology. The determination of the special function of different parts of the brain, and the fact ascertained by anatomists that each of these parts is related to other parts by means of great bundles of nerve fibers which pass throughout the brain in many directions, joining the different functional areas with one another, have led to the study of the association processes which lie at the basis of most of our thinking.

Mental images never occur singly, but are usually in close relation with other images, the result of simultaneous perceptions. The various qualities of an object perceived by different senses are united in our concept of the object. The beautiful form of the rose, its charming color, its delicate odor, the soft, velvety feel of its petals, and the sharp prick of its thorns all come into my consciousness through various channels, but, being simultaneous in their perception, are all joined with one another in a complex unit—the concept; and when I call to mind a rose, it is not one memory of a single sensation which comes into my consciousness, but it is the associated memory pictures of sight and smell and touch which, by a flash of consciousness, rise together into the mind. And since it is possible to analyze these sensations, it is also possible to trace the association between them. I do not hesitate to call to mind the appearance of the rose, even though I merely perceive its delicate perfume, and there is hardly a flower whose name is not brought up the moment I see or smell it. Yet this process of calling up the image of the flower from its odor, or of calling up its name when I see it, involves a process of transmission of physical impulses from one region of the brain to another—a process of which the physiological psychologist has actually determined the time. We measure associations in hundredths of a second, and with decided accuracy. The mental act of ordinary single association may be said to occupy an eighth of a second. The time of the transmission of these impulses varies decidedly at different periods of life, though it requires no delicate apparatus to convince one of the contrast between the quick, acute association of the young man and the slow, uncertain, halting memory of the aged. It has been found by Kroepelin that

the rapidity of the association processes can be altered by the use of certain drugs. Thus alcoholic beverages make the sensory perceptions and the process of thought slower than normal. They increase the rapidity of motor acts for a short time, but finally retard these, too. Tea has just the opposite effect, making sensations and intellectual acts more rapid, while it delays the motor actions. Morphine has at first much the same effect as tea, but soon after it delays all mental acts.

I have noticed that one of the early signs of beginning disease in the brain is a decided lengthening in the processes of association, even where none of these processes are absolutely suspended.

The number of associations permanently established with any given idea has been made the subject of tests, and it has been said that it is a better measure of the mental capacity of an individual to ascertain the number of associations which he possesses with any given subject than to require him to pass an examination upon his knowledge of the subject.

Among the curiosities of thought we may mention some queer disturbances in these processes of association. We may find that association tracts are apparently blocked so that a perception which should call up a certain concept fails to do so.

I have seen a man look at his own son and yet fail to recognize him—that is, the perception of the face no longer resulted in the quick spreading outward over a thousand associated tracts to other parts of the brain of impulses calculated to call up the numerous memory pictures usually associated with that face. Not long ago I asked a man who had one of these forms of defective association what his occupation was. He replied: "What I do? My business? I know just as well as I know all of it, but I can't tell." The idea of his occupation was unable to carry him on to its name. He was a printer. He assured me that he could call to mind his office with its presses and frames, but he could not name his occupation; yet he recognized the word printer at once when I spoke it, and knew it was what he wanted to say. One process of association, at least, in his brain was suspended.

Some of the extraordinary disturbances of consciousness in which an individual's personality appears to be divided, instances of which I shall give later, seem to be explicable only on the theory of the cessation of activity of the association fibers of the entire brain for a time.

I may mention here an unexpected association, a sort of spontaneous association between unrelated perceptions, which is observed in some minds. You may have heard that there is such a thing as color-hearing—i. e., persons subject to this forced association find that certain colors awaken forcibly the memory of certain sounds, which memory may be so vivid as to be a hallucina-

tion. A color may cause a shrill sound to be heard. I was told lately of a lady who was overcome by such a sound on entering a room where decorations, hangings, and furniture were red in color. On the other hand, certain sounds may awaken the idea of colors. I have heard of a man who seemed to see the color green when he heard a violin played; another person always had a sensation of red at the sound of a trumpet. Another person,* who had become blind, had retained this persistent association, and when the vowel sounds were pronounced slowly he had, accompanying each, a sensation of color like a transparent colored sheet a short distance in front of his face. Each vowel sound had its own corresponding tint, which was always the same for that vowel: *a* was red; *e*, gray; *i*, black; *o*, white; *u*, green. When the vowel sounds were uttered in rapid succession there appeared to be a confused, rapidly changing faint screen of color, but it did not obtrude itself on his consciousness unless he expressly directed his attention to it. This association persisted after this man had become blind. Many such instances have been recently collected by Flournay in his interesting book, Des Phénomènes de Synopsie. It is said that twelve per cent of people have such a power of color-hearing. It is certainly a fact that the most of us have an unpleasant involuntary feeling on hearing certain sounds. We all dislike the creaking noise of a slate pencil drawn across the slate or the sound produced by a man filing a saw. I think this is more than mere dislike of sound—it is a real sensation of a non-auditory and painful character—a forced, unnatural association.

Thirdly: The study of child life and of the mental development of the infant is the third line of research which has been of great service in the investigation of mental action. It is not possible for one accustomed to think without regarding his mental processes to suddenly stop in the course of thought and analyze accurately his methods of thinking. The rapidity of associations, their determination in certain lines by habit and by use, and their enormous number in the active mind, baffle all analysis. But if we watch the growth of thought in the child, if we notice the accumulation of memory pictures, the gradual building up of concepts and the formation of the links in the chain of reasoning, we can get at the elements of many complicated mental processes. Thus the study of the mental growth of the child throws light upon the study of adult thinking.

And here, too, the value must be recognized of the study of those imperfect minds which are arrested in their development at certain points. Thus, there are children whose powers of perception appear to grow with their growth, whose powers of recogni-

* Lancet, March 31, 1894.

tion of persons and objects about them are good, but who seem to stop short at the point where these individual perceptions and memories should be grouped together into general ideas. There is an inherent activity in the brain of a child which leads to thought and soon to actions and speech; yet there are children who never get to the point of definite purposeful activity. Such children are usually in constant motion, but their movements have no object. Such children can not be taught to talk, or, if they can be instructed in repeating words after another, they seem to attach little significance to the words that they say, and appear to have no spontaneous wish to talk. Back of any spontaneous desire to speak, there must be the idea which presses for utterance, and thus we conclude from the study of these defective, speechless creatures that while perception may be active, the mind has not grasped the subjects perceived, has not gone on to any generalization about them, or initiated a train of thought to issue in action or articulation. Such a child, then, reveals to us the order of progress in mental growth. It has the rudimentary power of simple perception and memory and association of memories; but it lacks the next higher power of thought, the power to group ideas together, to contrast them with each other, to generalize. And since it is this generalizing and analyzing power which stimulates thought and leads to natural curiosity, we find such children fail to give evidence of that desire for knowledge which a healthy child displays.

Another type of child far less defective is not uncommonly seen, who has nevertheless failed to reach that point of development which is evidenced by the power of self-control. These children may have the power to recognize objects, to analyze their qualities, to reason upon them, and to accumulate a little store of knowledge. They can talk, and learn to do many acts of a complex nature and of delicate manipulation. But the power of concentration of the mind upon a definite subject, the power of paying strict attention to one thing to the exclusion of all recognition of the thousand impressions which ordinarily press in upon consciousness and which the attentive mind ignores, this power they seem to lack, and hence, because of this defect in the attentive faculty, or of the power of controlling and directing mental action, these children are incapable of giving any stable direction to their life and conduct. I have a young man under my observation who is capable and active mentally in many directions, has apparently no gross intellectual defects, yet who complains that he is utterly unable to direct his mind continuously to any topic. He is a college graduate, but for the past ten years he has drifted about from one occupation or profession to another—eager for a time in each, then losing all interest, finding himself

unable to fix his attention any longer on his work, lapsing into a state of apathy and mental inertia, disappointed at himself and at his failure of interest, but incapable of arousing himself to effort. This is not laziness—it is an inherent mental defect.

Again, there is a type of mind which seems deficient only in the perception of the true relation between events and actions. These people are the victims of their fancies. They are constantly originating most impracticable undertakings. They expend their energy in devising and attempting to carry out the most useless, absurd, and extravagant schemes—sometimes selfish, sometimes apparently philanthropic. They appear to ignore or else can not appreciate the force of common-sense objections, or the reality of insuperable obstacles to their projects; and, finally, if they are defeated, they never blame themselves, but either complain of the lack of human sympathy, or become the victims of a delusion that they are the objects of a conspiracy by enemies whose existence is purely imaginary. The patent office contains a striking museum of such hopeless and visionary schemes and inventions.

It is impossible in the study of defective minds to draw any sharp lines between different individuals; and we can not help feeling that between the man of giant intellect on the one hand, and the speechless idiot on the other, there is an unbroken line of descent, and every possible variety of mental defect.

It is in some of these degenerate brains that we find some of the strangest curiosities of thinking, and some of those extraordinary developments in one line of mental capacity with a corresponding suppression of all other lines. One has only to think of such an individual as "Blind Tom," the pianist, who was a genius in music, able without instruction to reproduce upon the piano with marvelous elaboration of harmony almost anything musical which he had heard, and yet who was almost a brute so far as his moral nature was concerned, and almost an idiot so far as his intellectual powers could be measured. We might also cite a remarkable person recently seen in New York, "Inaudi," who, though until the age of twenty unable to read or write, because too stupid to learn, and manifestly defective in mental capacity, has a power of mathematical calculation which is most extraordinary and inexplicable. The most abstruse problems in arithmetic, such as cubes of numbers in four figures, or a square root of figures in millions, it takes him but a few seconds to solve, and this he has been able to do ever since a little boy, without being able at all to explain his methods of doing it. He is as accurate as a calculating machine (and just about as intelligent on other subjects). He relates his history as follows:*

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* New York Herald, March 25, 1894.

"I was born at Onorato, in Piedmont, on October 13, 1867.

"I began life as a shepherd boy, and when about six years old I went with my father into France. There I made a little living by wandering about from *café* to *café* dressed in my Savoyard's costume, and exhibiting some white mice which I had taught to perform some tricks.

"My brother taught me the names of the figures and their values, but the symbols which represent them were quite unknown to me. Indeed, it is only within the last five or six years that I have become at all familiar with them.

"As a matter of fact, the sight of figures embarrasses me even yet. It is through the sound, through the name of a figure, that my mind recognizes its value. If I see the sign which stands for it, I have to translate it, as it were, into a name familiar to my ear. Indeed, my eyes play no part at all in my process of calculation. 'Nine' conveys a distinct impression; the figure 9 has to be translated into 'nine' before I can do anything with it.

"The instant the names of the figures strike my ears the process of calculation begins. As one thing after another is disposed of, I place it on one side ready for reference in getting at the final result—not by mental vision, but by mental audition. I never, in thinking about numbers, see the figures; I hear them.

"My processes of calculation I had to invent. You see, I never learned arithmetic. When I had been taught the names of the figures by my brother my education came to an end. Instinctively I began to perform certain simple calculations. And, like all uneducated persons, I always calculate from left to right, instead of from right to left, beginning with the highest value instead of with the unit."

He himself, although perfectly conscious of the process through which his faculties work out the desired result, can not explain how he can arrive at that result so quickly. "It is there," he said, touching his head, "but the answer comes mechanically, without effort, without research, mechanically even."

"After a difficult calculation, do you experience any fatigue, M. Inaudi?" he was asked.

"Not the least in the world. I am quite unconscious of anything that is going on. Even the methods by which I arrive at the required result are so mechanically employed that it is simply like reading a newspaper." This indifference is proved by the fact that no interruption deranges M. Inaudi. He will listen and join in the conversation while continuing his unraveling of the problem. As an example of the rapidity of his power of calculation, it may be mentioned that it took him but twenty-three seconds to reckon the square of 5,892.

"When I take a pencil I work much slower than you would, and am not at all reliable. When I make a calculation mentally, the least error seems to strike my organ of hearing. I feel, if I can so express myself, the inaccuracy. When, on the other hand, I work with pen and paper, I might make several errors and should not discover them until I made the proof mentally."

This was naturally to be expected from one who frankly avowed that until a few years ago he was perfectly illiterate.

"I have no memory, however, for other things except figures," said M. Inaudi. "Nothing else seems to make any impression upon me. If I read anything, I forget it almost immediately. If anything is told to me, the result is the same. Few things interest me save numbers. In fact, I have no aptitude for anything else."

It is evident that Inaudi has a mind developed largely in one direction, but undeveloped in others.

Another instance of a lightning calculator may be mentioned, because he presents a wholly different method in his mental action. I refer to M. Diamandi, who has recently been examined carefully by Prof. Binet, of Paris.* Diamandi is able to perform wonderful feats of mathematical calculation with great rapidity, but he can not make his calculations until the numbers given him are written down. In other words, he is a visualist; he calls to mind numbers as they appear when seen. He says the numbers appear as if written on a mental table, which he sees and reads when he is asked to repeat numbers from memory. If Diamandi receives a problem by ear, he hesitates, appears embarrassed, commits errors, and demands a repetition. It is necessary for him to call up the visual image of the numbers heard. But when a problem is given in writing, he glances at the paper, then closes his eyes, makes an effort to call these numbers to mind, quickly goes through the calculation, and reaches the result, which he seems to himself to read off from the mental tablet. According to his statement, the numbers appear to him as if written in his own handwriting. Thus, if the problem is written in ink on a white paper, the figures in his mind appear in the same black color on white; but if it is written with chalk on a blackboard, it is thus that the result comes to his mind. His time of calculation is slightly longer than that of Inaudi, but he is equally exact. Some ingenious tests were made by Binet to prove the different methods of calculation in the two men. Several numbers were written beneath one another, forming a square, thus: and these were committed to memory by the two men. Diamandi looked at them. They were read to Inaudi. They were then asked to give the numbers, reading them downward instead of across and diagonally instead of across. Diamandi, having the visual picture, was able to do this in half the time of Inaudi, who had to call to mind the sounds and make selections.

9	7	6	4	5
6	3	2	1	4
5	4	3	7	8
3	8	6	5	1
7	9	1	4	2

The more the processes of thought in such minds are analyzed and contrasted with those in normal minds, the more apparent it becomes that each individual has his preference in mental imagery, and that in each person the mind habitually works more actively through one sense than through the others. This distinction was most acutely drawn by Charcot, who classified people into "visualists"—those whose recollections were chiefly of things seen, who had to read a name in order to remember it;

* Revue Philosophique, March, 1894.

"audists"—those whose memories were of things heard, whose auditory sense was paramount; and "motors"—whose powers were greatest in acts of expression, whose memory depended upon writing a thing down, whose talents lay in action. One can easily determine to which class one belongs by ascertaining in any act of memory whether he sees or hears or feels the thing remembered most easily, and by watching one's habitual references to memory. It may be remarked that such a discussion as that concerning universals in logic, in which the logicians ranged themselves in the rival camps of nominalists, realists, and conceptualists, probably had its origin in the various methods of habitual thinking in different minds. And in view of the facts of localization already described, it may be asserted that these inherent differences of thinking depend on various degrees of development of various districts of the brain cortex, or of the association fibers in these districts.*

Fourthly: From this type of mental development—presenting an excess in one direction, with or without defects in other directions—we will pass to another type of defective mind which has of late been most carefully studied, especially by M. Magnin, of Paris, the foremost French alienist.

There are certain persons in the community, usually the children of nervous or alcoholic parents, who present mental peculiarities which force upon us the conviction that there is a lack of equilibrium in their mental acts. They are not defective in faculties of sensation, memory, reasoning power, or action. They are often persons of brilliant qualities in certain directions, and perhaps have attained distinction in art or in the professions. But they may be the victims of sudden, unreasoning impulses, desires, doubts, or fears, which so dominate for the time their thought and acts as to lead one to the conclusion that their minds are not well balanced, though it can not be said that they are insane.

Let me give some examples from my own experience. A nervous woman began to notice her breathing, and for three months was beset with the fear that it would cease to continue if she did not watch it. She moved one of her fingers synchronously with her respiration; or else rocked in a chair, keeping time with the act of breathing. It was impossible to take her mind off of it. If she talked of something else, she was thinking of it all the

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* The examination of Laura Bridgman's brain supports this assertion. For this woman, who was unable to see or to hear, but whose means of communication with the external world was entirely by touch and by motion, had a brain whose visual and auditory regions were undeveloped, but whose sensori-motor region far exceeded in size that of a normal brain.

time and watched it. If she tried to stop thinking, she became anxious and distressed and had to continue. Finally, this condition passed away as suddenly as it came.

This, then, is an example of a fear relating to a simple physiological act, which calls the attention to the act, and gives rise to great distress of mind. I have seen persons who were unable to talk or to move a hand, or to walk, because of such a fear that they could not move; the fear appearing to suspend the power of volition. When the fear was quieted, and assurance regained, the power returned. In other cases, an imperative desire to do some absurd or useless thing seems to take possession of the mind. Thus, a little girl of delicate nervous organization, and who had been studying rather too earnestly in school, was suddenly seized with the impulse to count everything. If she enters a room she counts the chairs, the objects on a table, the bric-a-brac, or the pattern in a carpet. If she begins to talk, she has to count the words she says, or the words spoken by any one else, so that she is obliged to talk slowly, and is often so occupied in counting that she forgets what she is going to say before it is done. If she is made to stop, she feels great distress and a sense of anxiety which is painful.

Such fears may extend to higher mental acts involving volition.

One of the postmen whose duty it is to collect letters from the corner boxes in New York was recently discharged because he was always behind time on his rounds. He was much distressed at this, and finally revealed the reason: As he went about he would empty a box and lock it, but after going a few steps he would be seized with a fear that he had not locked the box, so he would go back and feel of it and assure himself that it was locked, and then start on again, but only to be again seized with this fear, which led to the impulse to return and try the box again. Thus, he would often return three or four times to each box emptied, and, of course, the delay made him so late on his rounds that he lost his place. He could not control the fear, or reason against it. The anxiety overcame him each time, and it was impossible to avoid the return.

A middle-aged lady, of much intellectual force and a keen power of analysis, had suffered from distressing mental tendencies ever since a child. These became very intense about her fortieth year, and remained for five years. She is abnormally conscientious—constantly imagines things which she ought to have done, and reproaches herself with not having done; or thinks of things which are wrong which she might do, and then reproaches herself for the thought. She once thought that she might thrust a needle into the eye of a person whom she loved;

she then reproached herself for this idea, felt that she had done this person a wrong, felt that she must make amends in some way, confessed her idea to the person, and was met by natural remonstrances which increased her distress. She lives with some relatives, and has a frequent impulse to go behind them and push them downstairs. She has never done so, but reproaches herself for the idea. If she sees a rug on the floor lying crooked, the idea comes to her that one of these relatives may stumble on it, and this for the moment gratifies her; then she reproaches herself for the thought, goes and fixes the rug; is not satisfied with the way she has fixed it; wonders if she could have placed it so that it could trip up this relative; fixes it again, over and over, sometimes twenty or thirty times, and can not get rid of the idea that after fixing it she would be guilty if her relative slipped upon it. The doubts extend to other things. She will turn out the gas on going to bed, then has to go back and feel of the fixture to be sure that it is turned out, and often repeats this twenty times before she can get rid of the idea that it is really turned on. In her room she has to arrange everything in a very precise manner, and often spends hours placing and replacing objects before she can satisfy herself that they are right. It is impossible for her to argue with herself regarding these matters, and if she resists the tendency to repeat an act she gets into a state of distress, with palpitation of the heart and every evidence of intense anxiety, which nothing will quiet except the repetition of the act.

A lady aged twenty-nine had mental symptoms since the age of eighteen, when great timidity in driving began. She gets nervous at any excitement. She is subject to morbid fears; sees a match-box, wonders if the matches are safe—might they get out, and be lighted and set things on fire?—hence, goes to the match-box, and makes sure it is shut; then goes back again, and so may repeat this twenty times. She can not reason with herself. Or, she wonders if the windows are shut; has to go and put her hand on the window to be sure, and this she does again and again. If she has medicine, she fears it will get out of the bottle; she goes and feels to see if the bottle is corked. She has the constant fear that things are not right, and has to reassure herself. Has to say things in a special way, and over and over, so it is hard for her to talk, and she repeats words. In reading she notices each word and can not read fast, but must read exactly; hence, she takes no pleasure in reading. Her condition makes her restless and melancholy. She is perfectly sane, but she is the victim of a morbid tendency to doubt the certainty of any idea which presents itself to the mind.

In all these cases the act which is done, and which is apparent-

ly absurd, is the outcome of a process of reasoning starting from a premise, which premise is an absurd fear or doubt. There is nothing wrong in the act or in the process of logical conclusion, granting the premise. The premise is, however, a false idea forced upon the consciousness so intensely as to carry conviction. It is quite analogous to a hallucination in the domain of sensory perception, but it belongs to the ideational sphere, or to the emotional sphere of mind. You will have noticed that the same sort of doubts occur to different minds.

It may be said that such fears, doubts, or impulses might occur to any one, but could be at once discarded. In the fact that they are not discarded, that there is a lack of self-control and mental balance which allows of their taking possession of the mind, lies the proof that in such cases there is a defect of mental development. Such cases show us clearly how important it is to sound normal mental action that a firm control over the tendencies of the mind to wander foolishly, to indulge in absurd doubts and fears, should be constantly exercised; and such control should be inculcated upon the child's mind as it develops, lest the individual come to yield to or to foolishly fear these abnormal impulses. That self-control is the highest quality of mind is evident from the fact that the first evidence of mental deterioration is seen in a beginning failure of this power.

You are all familiar with the fact that many acts of an insane kind are spontaneous, and not the result of a process of logical reasoning. Thus, a sudden impulse to steal, or to set fire to an object, may come upon one and lead to the act, for which no explanation can be given except the sudden onset of an abnormal and irresistible desire. These acts are in a way as unexpected as the hallucinations or the doubts or fears, and like them must be ascribed to sudden excitation of brain functions beyond our control from internal causes, the effects of disease. Such acts are not of much interest to the student of psychology, for they do not involve a process of thought. They are most commonly observed, however, in persons of the degenerate type which we have been studying. In these persons, then, of degenerate type we observe an imperfect mental equilibrium, which prevents a successful resistance of sudden impulses, and a successful suppression of sudden doubts and fears, and which thus deprives the victim of his liberty of action in spite of his conscious knowledge that the impulses or doubts are absurd or wrong. From time to time in their lives these persons suffer for weeks and months from their mental distress; then, for unknown reasons, they may be free from it, but usually it returns, and it is an annoyance through the entire life. One of the most interesting studies of the mental processes of a person thus afflicted has been published by Prof. Royce,

of Harvard, in the American Psychological Review—the case of John Bunyan.

Lastly, there is one other curiosity of thinking which as yet remains unexplained, but which at present is exciting a considerable degree of interest. I refer to the condition known as double consciousness. Let me give an illustration.

A young man, a carpenter by trade, of fair intelligence and good physique, had a severe fall upon the head in January, 1879, and subsequently to that time suffered from occasional attacks of unconsciousness with convulsions, which were thought to be epileptic. He was treated from July, 1884, until January 10, 1885, for this disease, and during that time had no attacks. On January 10th he came home from work as usual, ate his supper, and went to bed. He slept with his brother, who is sure that during the night he had no convulsion. The patient says that when he woke up on the 11th of January he found himself in Bellevue Hospital, and learned to his surprise that it was evening. He has no recollection of anything which occurred beween going to bed on Friday night and waking in the hospital on Saturday night. From his family, however, it was ascertained that he got up as usual on Saturday morning, and while it was noticed that he acted a little strangely at breakfast nothing was said to him, and he went as usual to work. His employer thought that his eyes looked brighter (possibly his pupils were dilated) and that he did not appear natural, but he took no special notice of this, and soon after his arrival at the shop in Twenty-fourth Street he sent him up to a house in Forty-sixth Street (about a mile) on an errand, to obtain a carpenter's bit and brace. He went up to Forty-sixth Street, did the errand, and evidently explained himself intelligently, for he was given the bit and brace. The next trace he has of his movements was at Eighth Avenue, near Bleecker Street (about two miles away), though how he got there he does not know. He there went into a plumber's shop, and asked to be allowed to sit down and rest. He had nothing in his hands, so must have lost the bit and brace on the way. He soon got into a lively talk with the plumber, and became quarrelsome, so that he was told to go out. He went away, but in an hour came back, entered the shop, and tried to strike the plumber. This was for him an unusual proceeding, as he is of a mild and gentle disposition. An officer was summoned, who took him to the police station, where it was evident that he was out of his head; so they sent him to St. Vincent's Hospital, whence he was at once transferred to Bellevue. He fell asleep soon after admission to Bellevue, and on waking in an hour or so was surprised to find where he was. His manner of talking made it evident that nothing was the matter with him, and he was discharged at once and went home, rather indignant at hav-

ing been sent to a hospital, and anxious to find out the reason. Being a very intelligent lad, he became interested in his own case at once, on learning a few of the facts, and ascertained by inquiry the various occurrences which have just been described. Soon after this I lost track of him, and do not know whether any similar attacks have since occurred.

It would be easy to offer other illustrations of a condition of mind very properly termed double consciousness. It is as if a single individual had two separate and distinct personalities, neither of which has anything in common with the other. All associations, all memories of one condition seem to be blotted out or suspended when the person is in the other condition. It is a remarkable fact that such a state is usually produced by a blow or a fall, and it is a well-recognized complication of railway injuries and of severe accidents that such a state of secondary consciousness may follow for several hours or days, but in the case here related nothing of this kind preceded the onset. And it must be remembered that such a state of secondary consciousness or abnormal personality may also be produced by hypnotic suggestion. Persons who are hypnotized are in a condition quite similar to that described as a state of secondary consciousness—that is, they have no recollection of what has happened before they were put in the hypnotic condition, and after they are awakened they have no recollection of what has happened in the hypnotic condition. Yet in that condition they are able to reply to questions intelligently, and if they are hypnotized a second time their memory of what has occurred on the first occasion is continuous with their memory of what occurs upon the second. Such cases have been described with much care by Paul Janet.

The same phenomena are observed in a less degree in somnambulists, for what a sleep-walker may do one night he may undo on a second night, though having absolutely no recollection of either occurrence in his waking hours.

There is no satisfactory explanation as yet found for these extraordinary alterations of consciousness and personality, and there is much opportunity for study and research in regard to these peculiar conditions. They remain among the curiosities of thinking, inexplicable yet interesting.

MONTENEGRO has long enjoyed a complete system of local government. Among the people, three hundred thousand in number, are five hundred village councils, elected every three years, ruled by popularly elected officers, levying rates, distributing charities, appointing supervisors of education, whose duty it is to deliver popular lectures on its advantages, "and finding the solution of the problem of women's rights," says Mr. W. H. Cozens-Hardy, "in allowing women to speak in the village meetings as long as they may wish, but to vote not at all."

PLEASURES OF THE TELESCOPE.

By GARRETT P. SERVISS.

IV.—VIRGO AND HER NEIGHBORS.

FOLLOWING the order of right ascension, we come next to the little constellations Crater and Corvus, which may be described as standing on the curves of Hydra (map No. 8). Beginning with Crater, let us look first at α, a yellow fourth-magnitude star, near which is a celebrated red variable R. With a low power we can see both α and R in the same field of view like a very wide double. There is a third star of ninth magnitude, and bluish in color, near R on the side toward α. R is variable both in color and light. When reddest, it has been described as "scarlet," "crimson," and "blood-colored"; when palest, it is a deep orange-red. Its light variation has a period the precise length of which is not yet known. The cycle of change is included between the eighth and ninth magnitudes.

While our three-inch telescope suffices to show R, it is better to use the five-inch, because of the faintness of the star. When the color is well seen, the contrast with α is very pleasing.

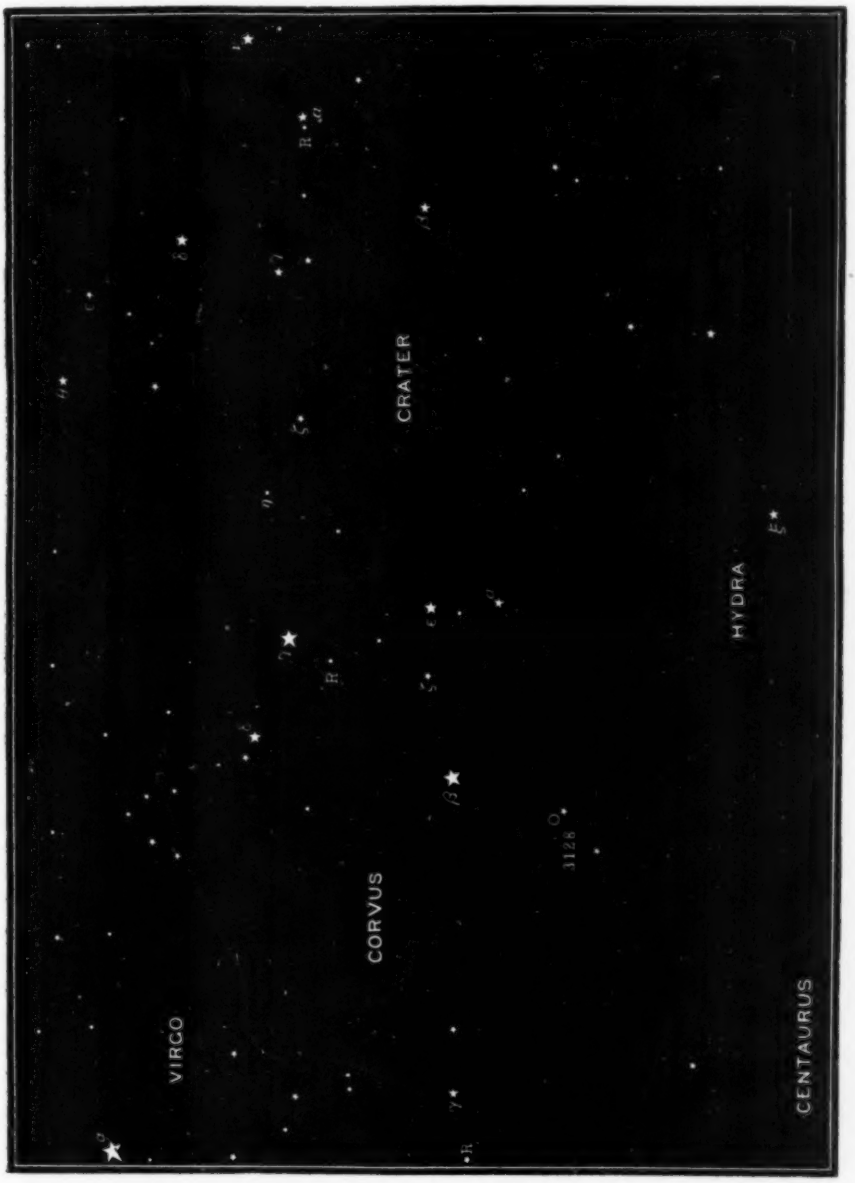
There is hardly anything else in Crater to interest us, and we pass over the border into Corvus, and go at once to its chief attraction, the star δ. The components of this beautiful double are of magnitudes three and eight; distance 24″, p. 211°; colors yellow and purple.

The night being dark and clear, we take the five-inch and turn it on the nebula 3128, which the map shows just under the border of Corvus in the edge of Hydra. Herschel believed he had resolved this into stars. It is a faint object and small, not exceeding one eighth of the moon's diameter.

Further east in Hydra, as indicated near the left-hand edge of map No. 8, is a somewhat remarkable variable, R Hydræ. This star occasionally reaches magnitude three and a half, while at minimum it is not much above the tenth magnitude. Its period is about four hundred and twenty-five days.

While we have been examining these comparatively barren regions, glad to find one or two colored doubles to relieve the monotony of the search, a glittering white star has frequently drawn our eyes eastward and upward. It is Spica, the great gem of Virgo, and, yielding to its attraction, we now enter the richer constellation over which it presides (map No. 9). Except for its beauty, which every one must admire, Spica, or α Virginis, has no special claim upon our attention. Some evidence has been obtained that, like β Aurigæ, it revolves with an invisible com-

panion of great mass in an orbit only six million miles in diameter. Spica's spectrum resembles that of Sirius. The faint star which our larger apertures show about 6′ northeast of Spica is of the tenth magnitude.



Map No. 8.

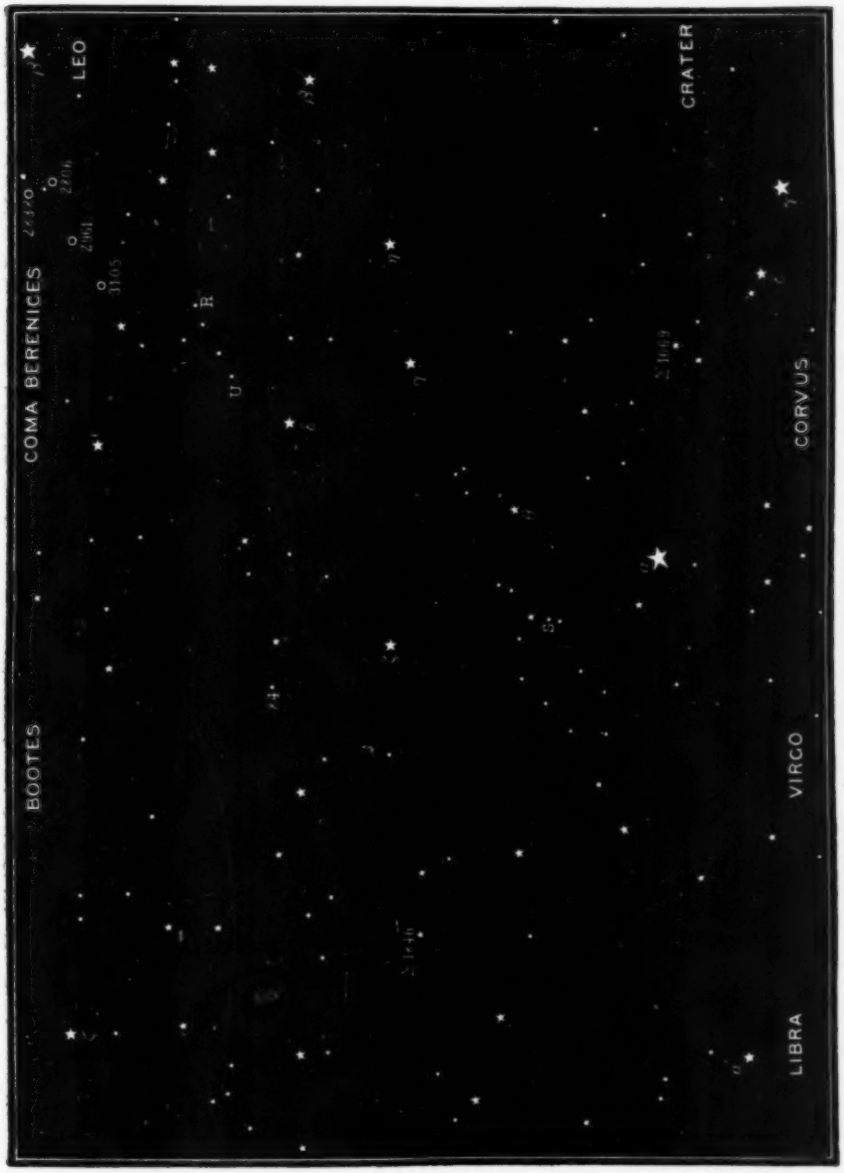
Sweeping westward, we come upon Σ 1669, a pretty little double with nearly equal components of about the sixth magnitude; distance 5·6″, p. 124°. But our interest is not fully aroused

until we reach γ, a star with a history. The components of this celebrated binary are both nearly of the third magnitude, distance about 5·9″, p. 150°. They revolve around their common center in something less than two hundred years. According to some authorities, the period is one hundred and seventy years, but it is not yet certainly ascertained. It was noticed about the beginning of the seventeenth century that γ Virginis was double. In 1836 the stars were so close together that no telescope then in existence was able to separate them, although it is said that the disk into which they had merged was elongated at Pulkowa. In a few years they became easily separable once more. If the one-hundred-and-seventy-year period is correct, they should continue to get farther apart until about 1921. According to Asaph Hall, their greatest apparent distance is 6·3″, and their least apparent distance 0·5″; consequently, they will never again close up beyond the separating power of existing telescopes.

There is a great charm in watching this pair of stars even with a three-inch telescope—not so much on account of what is seen, although they are very beautiful, as on account of what we know they are doing. It is no slight thing to behold two distant stars obeying the law that makes a stone fall to the ground and compels the earth to swing round the sun.

In θ we discover a fine triple, magnitudes four and a half, nine, and ten; distances 7″, p. 345°, and 65″, p. 295°. The ninth-magnitude star has been described as "violet," but such designations of color are often misleading when the star is very faint. On the other hand it should not be assumed that a certain color does not exist because the observer can not perceive it, for experience shows that there is a wide difference among observers in the power of the eye to distinguish color. I have known persons who could not perceive the difference of hue in some of the most beautifully contrasted colored doubles to be found in the sky. Such persons miss one of the finest pleasures of the telescope. In examining θ Virginis we shall do best to use our largest aperture, viz., the five-inch. Yet Webb records that all three of the stars in this triple have been seen with a telescope of only three inches aperture. The amateur must remember in such cases how much depends upon practice as well as upon the condition of the atmosphere. There are lamentably few nights in a year when even the best telescope is ideally perfect in performance, but every night's observation increases the capacity of the eye, begetting a kind of critical judgment which renders it to some extent independent of atmospheric vagaries. It will also be found that the idiosyncrasies of the observer are reflected in his instrument, which seems to have its fits of excellence, its inspirations so to speak, while at other times it behaves as if all its wonderful powers had departed.

Another double that perhaps we had better not try with less than four inches aperture is 84 Virginis. The magnitudes are six and nine; distance, 3·5″, p. 233°. Colors, yellow and blue. Σ 1846



Map No. 9.

is a fifth-magnitude star with a tenth-magnitude companion, distance only 4″, p. 108°. Use the five-inch.

And now we approach something that is truly wonderful, the "Field of the Nebulæ." This strange region, lying mostly in the

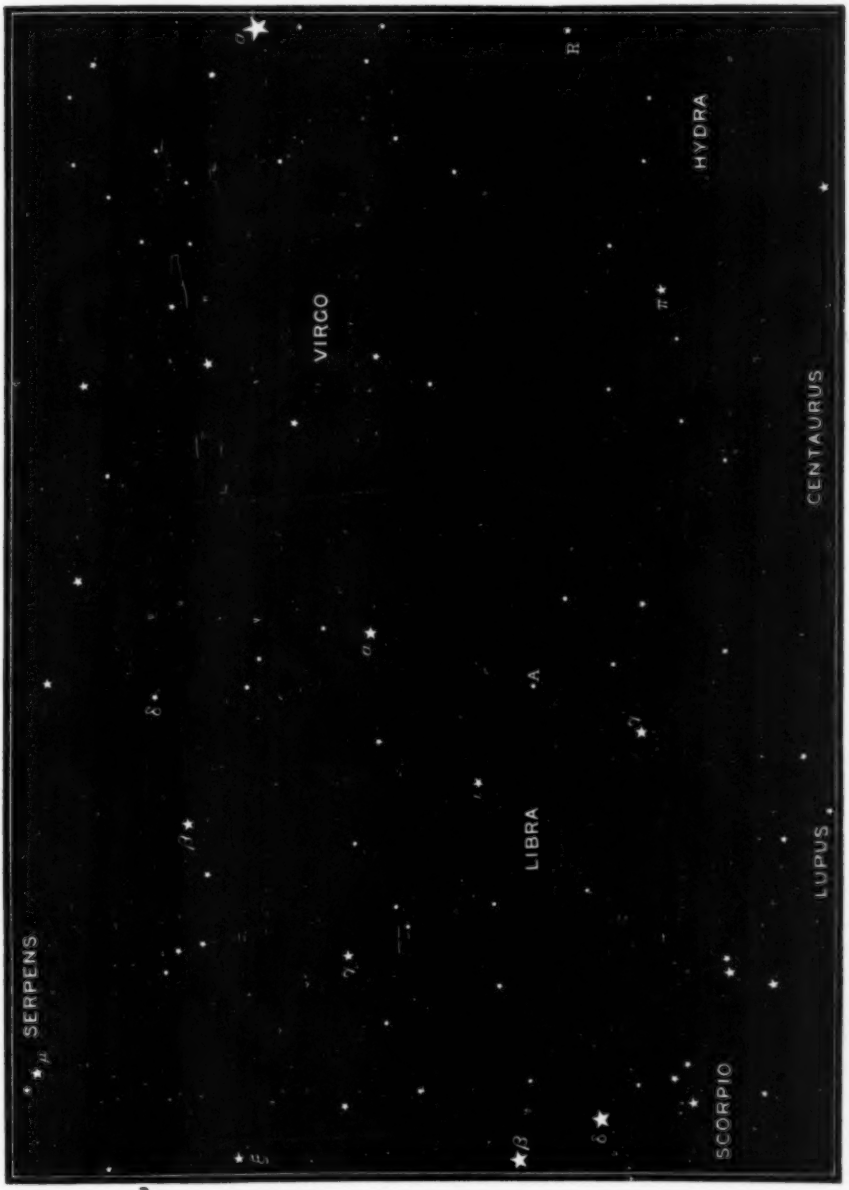
constellation Virgo, is roughly outlined by the stars β, η, γ, δ, and ϵ, which form two sides of a square some 15° across. It extends, however, for some distance into Coma Berenices, while outlying nebulæ belonging to it are also to be found in the eastern part of Leo. Unfortunately for those who expect only brilliant revelations when they look through a telescope, this throng of nebulæ consists of small and inconspicuous wisps as ill defined as bits of thistle-down floating high in the air. There are more than three hundred of them all told, but even the brightest are faint objects when seen with the largest of our telescopes. Why do they congregate thus? That is the question which lends an interest to the assemblage that no individual member of it could alone command. It is a mystery, but beyond question it is explicable. The explanation, however, is yet to be discovered.

The places of only three of the nebulæ are indicated on the map. No. 2806 has been described as resembling in shape a shuttle. Its length is nearly one third of the moon's diameter. It is brightest near the center, and has several faint companions. No. 2961 is round, 4′ in diameter, and is accompanied by another round nebula in the same field of view toward the south. No. 3105 is double, and powerful telescopes show two more ghostly companions. There is an opportunity for good and useful work in a careful study of the little nebulæ that swim into view all over this part of Virgo. Celestial photography has triumphs in store for itself here.

Scattered over and around the region where the nebulæ are thickest we find eight or nine variable stars, three of the most remarkable of which, R, S, and U, may be found on the map. R is very irregular, sometimes attaining magnitude six and a half, while at other times its maximum brightness does not exceed that of an eighth-magnitude star. At minimum it sinks to the tenth or eleventh magnitude. Its period is one hundred and forty-five days. U varies from magnitude seven or eight down to magnitude twelve or under and then regains its light, in a period of about two hundred and seven days. S is interesting for its brilliant red color. When brightest, it exceeds the sixth magnitude, but at some of its maxima the magnitude is hardly greater than the eighth. At minimum it goes below the twelfth magnitude. Period, three hundred and seventy-six days.

Next east of Virgo is Libra, which contains a few notable objects (map No. 10). The star α has a fifth-magnitude companion, distant about 230″, which can be easily seen with an opera glass. At the point marked A on the map is a curious multiple star, sometimes referred to by its number in Piazzi's catalogues as follows: 212 P. xiv. The two principal stars are easily seen, their magnitudes being six and seven and a half; distance 15″, p.

290°. Burnham found four other faint companions, for which it would be useless for us to look. The remarkable thing is that these faint stars, the nearest of which is distant about 50″ from



Map No. 10.

the largest member of the group and the farthest about 120″ do not share, according to their discoverer, in the rapid proper motion of the two main stars.

In ε we find a double a little difficult for our three-inch. The

components are of magnitudes four and a half and ninth, distance 57″, p. 110°. Burnham discovered that the ninth-magnitude star consists of two of the tenth less than 2″ apart, p. 24°.

No astronomer who happens to be engaged in this part of the sky unless his attention is entirely absorbed by something of special interest, ever fails at least to glance at β Libræ, which is famous as the only naked-eye star having a decided green color. The hue is pale, but manifest.*

The star δ is a remarkable variable, belonging to what is called the Algol type. Its period, according to Chandler, is 2 days, 7 hours, 51 minutes, 22·8 seconds. The time occupied by the actual changes is about twelve hours. At maximum the star is of magnitude five and at minimum of magnitude 6·2.

We may now conveniently turn northward from Virgo in order to explore Boötes, one of the most interesting of the constellations (map No. 11). Its leading star α, Arcturus, is the brightest in the northern hemisphere. Its precedence over its rivals Vega and Capella has been settled by the Harvard photometry. You notice that the color of Arcturus, when it has not risen far above the horizon, is a yellowish red, but when the star is near mid-heaven the color fades to yellow. The hue is possibly variable, for it is recorded that in 1852 Arcturus appeared to have nearly lost its color. If it should eventually turn white, the fact would have an important bearing upon the question whether Sirius was once a red or flame-colored star.

But let us sit here in the starlight, for the night is balmy, and talk about Arcturus, which is perhaps actually the greatest sun within the range of terrestrial vision. Its parallax is so minute that the consideration of the tremendous size of this star is a thing that the imagination can not placidly approach. Calculations, based on its assumed distance, which show that it *outshines the sun several thousand times* may be no exaggeration of the truth! It is easy to make such a calculation. Dr. Elkin's parallax for Arcturus is 0·018″. That is to say, the displacement of Arcturus due to the change in the observer's point of view when he looks at the star first from one side and then from the other side of the earth's orbit, 186,000,000 miles across, amounts to only eighteen one-thousands of a second of arc. We can appreciate how small that is when we know that it is about equal to the apparent distance between the heads of two pins placed an inch apart and viewed from a distance of a hundred and eighty miles!

Assuming this estimate of the parallax of Arcturus, let us see how it will enable us to calculate the probable size or light-giv-

* Has the slight green tint perceptible in Sirius deepened of late? I am sometimes disposed to think it has.

ing power of the star as compared with the sun. The first thing to do is to multiply the earth's distance from the sun, which may be taken at 93,000,000 miles, by 206,265, the number of seconds of arc in a radian, the base of circular measure, and then divide the product by the parallax of the star. Performing the multiplication and division, we get the following:

$$\frac{19,182,645,000,000}{\cdot 018} = 1,065,790,250,000,000.$$

The quotient represents miles! Call it, in round numbers, a thousand millions of millions of miles. This is about 11,400,000 times the distance from the earth to the sun.

Now for the second part of the calculation: The amount of light received on the earth from some of the brighter stars has been experimentally compared with the amount received from the sun. The results differ pretty widely, but in the case of Arcturus the ratio of the star's light to sunlight may be taken as about one twenty-five-thousand-millionth—i. e., 25,000,000,000 stars, each equal to Arcturus, would together shed upon the earth as much light as the sun does. But we know that light varies inversely as the square of the distance; for instance, if the sun was twice as far away as it is, its light would be diminished for us to a quarter of its present amount. Suppose, then, that we could remove the earth to a point midway between the sun and Arcturus, we should then be 5,700,000 times as far from the sun as we now are. In order to estimate how much light the sun would send us from that distance we must square the number 5,700,000 and then take the result inversely, or as a fraction. We thus get $\frac{1}{32,490,000,000,000}$, representing the ratio of the sun's light at half the distance of Arcturus to that at its real distance. But while receding from the sun we should be approaching Arcturus. We should get, in fact, twice as near to that star as we were before, and therefore its light would be increased for us fourfold. Now, if the amount of sunlight had not changed, it would exceed the light of Arcturus only a quarter as much as it did before, or in the ratio of $\frac{25,000,000,000}{4} = 6,250,000,000$ to 1. But, as we have seen, the sunlight would diminish through increase of distance to one 32,490,000,000,000th part of its original amount. Hence its altered ratio to the light of Arcturus would become 6,250,000,000 to 32,490,000,000,000, or 1 to 5,198.

This means that if the earth were situated midway between the sun and Arcturus, it would receive 5,198 times as much light from that star as it would from the sun! It is quite probable, moreover, that the heat of Arcturus exceeds the solar heat in the same ratio, for the spectroscope shows that although Arcturus is

surrounded with a cloak of metallic vapors proportionately far more extensive than the sun's, yet, smothered as the great star

Map No. 11.

seems in some respects to be, it rivals Sirius itself in the intensity of its radiant energy.

If we suppose the radiation of Arcturus to be the same per unit of surface as the sun's, it follows that Arcturus exceeds the

sun about 375,000 times in volume, and that its diameter is no less than 62,350,000 miles! Imagine the earth and the other planets constituting the solar system removed to Arcturus and set revolving around it in orbits of the same forms and sizes as those in which they circle about the sun. Poor Mercury! For that little planet it would indeed be a jump from the frying pan into the fire, because, as it rushed to perihelion, Mercury would plunge more than 2,500,000 miles beneath the surface of the giant star. Venus and the earth would perhaps melt like snowflakes at the mouth of a furnace. Even far-away Neptune, the remotest member of the system, would be bathed in torrid heat.

But stop! Look at the sky. Observe how small and motionless the disks of the stars have become. Back to the telescopes at once, for this is a token that the atmosphere is steady, and that "good seeing" may be expected. It is fortunate, for we have some delicate work before us. The very first double star we try in Boötes, Σ 1772, requires the use of the four-inch, and the five-inch shows it more satisfactorily. The magnitudes are sixth and ninth, distance 5″; p. 140°. On the other side of Arcturus we find ζ, a star that we should have had no great difficulty in separating thirty years ago, but which has now closed up beyond the reach even of our five-inch. The magnitudes are both fourth, and the distance about 0·5″, p. 285°. It is apparently a binary, and if so will some time widen again, but its period is unknown. The star 279, also known as Σ 1910, near the southeastern edge of the constellation, is a pretty double, each component being of the seventh magnitude; distance 4″; p. 212°. Just above ζ we come upon π, an easy double for the three-inch, magnitudes fourth and sixth; distance 6″; p. 99°. Next is ξ, a yellow and purple pair, whose magnitudes are respectively fifth and seventh; distance less than 3″; p. 231°. This is undoubtedly a binary with a period of revolution of about a hundred and thirty years. Its distance decreased about 1″ between 1881 and 1891. It was still decreasing in 1894, when it had become 2·9″. The orbital swing is also very apparent in the change of the position angle.

The telescopic gem of Boötes, and one of "the flowers of the sky," is ε, also known as Mirac. When well seen, as we shall see it to-night, ε Boötis is superb. The magnitudes of its two component stars are two and a half (according to Hall, three) and six. The distance is about 2·8″, p. 326°. The contrast of colors—bright orange yellow, matched with brilliant emerald green—is magnificent. There are very few doubles that can be compared with it in this respect. The three-inch will separate it, but the five-inch enables us best to enjoy its beauty. It appears to be a binary, but the motion is very slow, and nothing certain is yet known of its period.

In δ we have a very wide and easy double; magnitudes three and a half and eight and a half; distance 110″, p. 75°. The smaller star has a lilac hue. We can not hope with any of our instruments to see the three stars contained in μ, but two of them are easily seen; magnitudes four and seven; distance 108″, p. 172°. The smaller star is again double; magnitudes seven and eight; distance 0·77″, p. 88°. It is clearly a binary, with a long period. A six-inch telescope that could separate this star at present would be a treasure. Σ 1926 is another object rather beyond our powers, on account of the contrast of magnitudes. These are six and eight and a half; distance 1·3″, p. 256°.

Other doubles are: 44 (Σ 1909), magnitudes five and six; distance 4·8″, p. 240°; 39 (Σ 1890), magnitudes both nearly six; distance 3·6″, p. 45°. Smaller star light red; ι, magnitudes four and a half and seven and a half, distance 38″, p. 33°; κ, magnitudes five and a half and eight, distance 12·7″, p. 238°. Some observers see a greenish tinge in the light of the larger star, the smaller one being blue.

There are one or two interesting things to be seen in that part of Canes Venatici which is represented on map No. 11. The first of these is the star cluster 3936. This will reward a good look with the five-inch. With large telescopes as many as one thousand stars have been discerned packed within its globular outlines.

The star 25 (Σ 1768) is a close binary with a period estimated at one hundred and twenty-five years. The magnitudes are six and seven or eight, distance about 1″, p. 137°. We may try for this with the five-inch, and if we don't succeed in separating the stars we may hope to do so some time, for the distance between them is increasing.

Although the nebula 3572 is a very wonderful object, we shall leave it for another evening.

Eastward from Boötes shines the circlet of Corona Borealis, whose form is so strikingly marked out by the stars that the most careless eye perceives it at once. Although a very small constellation, it abounds with interesting objects. We begin our attack with the five-inch on Σ 1932, and we may heartily congratulate ourselves if we come off victors, for this binary has been slowly closing for many years. The magnitudes are six and a half and seven, distance 0·94″, p. 317°. Not far distant is another binary, at present beyond our powers, η. Here the magnitudes are both six, distance 0·86″, p. 245°. Hall assigns a period of forty years to this star. It is widening,

The assemblage of close binaries in this neighborhood is very curious. Only a few degrees away we find one that is still more remarkable, the star γ. What has previously been said about 42 Comæ Berenicis applies in a measure to this star also. It, too,

has a comparatively small orbit, and its components are never seen widely separated. In 1826 their distance was 0·7″; in 1880 they could not be split; in 1891 the distance had increased to 0·36″, and in 1894 it had become 0·53″, p. 123°. The period has been estimated at one hundred years.

While the group of double stars in the southern part of Corona Borealis consists, as we have seen, of remarkably close binaries, another group in the northern part of the same constellation comprises stars that are easily separated. Let us first try ζ. The powers of the three-inch are amply sufficient in this case. The magnitudes are four and five, distance 6·3″, p. 300°. Colors, white or bluish-white and blue or green.

Next take σ, whose magnitudes are five and six, distance 4″, p. 206°. With the five-inch we may look for a second companion of the tenth magnitude, distance 54″, p. 88°. It is thought highly probable that σ is a binary, but its period has simply been guessed at.

Finally, we come to ν, which consists of two very widely separated stars, ν^1 and ν^2, each of which has a faint companion. With the five-inch we may be able to see the companion of ν^2, the more southerly of the pair. The magnitude of the companion is variously given as tenth and twelfth, distance 137″, p. 18°.

With the aid of the map we find the position of the new star of 1866, which is famous as the first so-called temporary star to which spectroscopic analysis was applied. When first noticed, on May 12, 1866, this star was of the second magnitude, fully equaling in brilliancy α, the brightest star of the constellation; but in about two weeks it fell to the ninth magnitude. Huggins and Miller eagerly studied the star with the spectroscope, and their results were received with the deepest interest. They concluded that the light of the new star had two different sources, each giving a spectrum peculiar to itself. One of the spectra had dark lines and the other bright lines. It will be remembered that a similar peculiarity was exhibited by the new star in Auriga in 1893. But the star in Corona did not disappear. It diminished to magnitude nine and a half or ten, and stopped there; and it is still visible. In fact, subsequent examination proved that it had been catalogued at Bonn as a star of magnitude nine and a half in 1855. Consequently this "blaze star" of 1866 will bear watching in its decrepitude. Nobody knows but that it may blaze again. Perhaps it is a sunlike body; perhaps it bears little resemblance to a sun as we understand such a thing. But whatever it may be, it is there, and it has proved itself capable of doing very extraordinary things.

We have no reason to suspect the sun of any latent eccentricities like those that have been displayed by "temporary" stars; yet, acting on the principle which led the old emperor-astrologer

Rudolph II to torment his mind with self-made horoscopes of evil import, let us unscientifically imagine that the sun *could* suddenly burst out with several hundred times its ordinary amount of heat and light, thereby putting us into a proper condition for spectroscopic examination by curious astronomers in distant worlds.

But no, it is far pleasanter to keep within the strict boundaries of science, and not imagine anything of the kind.

THE SUCCESSOR OF THE RAILWAY.

By APPLETON MORGAN.

WITHIN the few years remaining to the nineteenth century, if not indeed already, will certainly pass away the human being who can remember a date when there were no railways. A railway then will be, if it is not already, as much part of a natural landscape as a mountain or a river, since no one can then recall a time at which railways as well as rivers did not run.

Our nineteenth century has been the railway age. Within its bounds the railway has been entirely conceived, invented, utilized, and perfected. But will the century which has been the birth and genesis of the railway witness also its exodus and its death? Perhaps not; and yet—perhaps. It has been anticipated and foreseen that electricity was to be the successor of steam, and experimental electric locomotives have already been operated with more or less satisfactory results. But the question appears at this moment to be, not whether the electric locomotive will supersede the steam locomotive, but whether locomotives themselves are not to be dispensed with, and tossed, together with drawings, models, plans, specifications, and estimates for a substitution of power, upon the scrap heap, while the substitution shall be, not of the motive power, but of the motor.

It looks, indeed, as if the next century, whatever it may have in the way of aërial flight in store for us, will have no difficulty, if it desires the honor, of being christened "the trolley age." For it is to this new traction system that the railway companies are already looking with that apprehension with which an heirless landed proprietor regards his hostile next of kin. Loaded down with their vast burden of fixed charges and costly maintenance, crippled by all sorts of parasites, legal, illegal, and mixed, there seems to be nothing for them to do but to wait patiently to be superseded.

For many years the railway companies had come to philosophize helplessly at the prospective diminution of suburban profits from the horse or dummy-operated tramway, and had missed the

out-of-town patron who had begun to turn his back upon comfortable sittings and smokers, sumptuous saloons, luxurious upholstery, facilities for his traveling whist or chess, heat, water, and conveniences galore. They had without a murmur seen all these pale in attraction to the man of business, who needed not to await time tables or succumb to belated or missed trains, when the buzzing little trolley hummed along its inexpensive wires every five minutes, so long as it afforded him a board bench or a strap to hang on by. But when this unexpected trolley began to go farther and stretch its transportation powers to longer distances, the poor handicapped railways were led to look at their books and—if metaphors may be mixed—to button up their pockets and hint of receivers instead of dividends. And just at present they may be praying for time to turn around before a transcontinental trolley is upon them!

The trolley indeed has, in less space of time than that required to launch any other known improvement, practically captured the cheap transportation field. This newcomer, indeed, seems equipped with every opportunity that the railways have been coveting for fifty years, and to be getting for the asking everything for which the railways have to pay the heaviest. Its economies began at its very birth. In its construction it has no use for high-salaried engineering and locating parties; for woodsmen, excavators, dumpers, agents of rights of way, and for the long catalogue of machinery for surveying and making a railway line. All these become as superfluous and as clumsy as the Old Man of the Sea on Sindbad's back; for, while your principal assistants are putting on their rubber boots, your trolley—built in a night, like Aladdin's palace—is earning dividends, oblivious of summits or watersheds or grades, loops or bridges, trusses or cantilevers. It is only an item of the situation that, as fast as charters can be mobilized or capital adjusted or plants converted, the dummies are side-tracked, horses led to auction, while every species of tramway spins its overhead wires and becomes trolleyized into remunerative investments. We sometimes smile at the non-perspiring Philadelphian pace; but here are in evidence, from the calm City of Brotherly Love, figures of a month's operation of a single line where the trolley has just replaced the horse, to wit: Four hundred and fifty horses that were formerly used on the road consumed in a month ninety-two and a half tons of cut hay, about eight thousand pounds of feed, and two tons of straw. This, with shoeing, cost the company about four thousand five hundred dollars. Offsetting this, the coal consumed in one month's working cost five hundred and eighty-five dollars, a clear saving by the trolley of three thousand nine hundred and fifteen dollars. On an average, eighty men were employed

around the stables and in the car sheds for looking after these four hundred and fifty horses. For these the company substitutes two or three electrical operatives, and saves about five thousand dollars a month in expenses, and anticipates an increase besides of twenty-five per cent on receipts by the increase of business, by the saving of time and the doubling of train schedules.*

Against such startling economies as these economists would ordinarily place the usual offsets of more highly skilled and better-paid labor required to handle the more subtile and complicated motive. Such a rule should apparently best operate in a case when an invisible power is substituted for one, where ethereal energy so literally takes the place of brute force as when electricity supersedes a horse. In every other *situs* the rule would obtain. When we put a criminal to death by hanging, any boor could haul at or cut a rope, but when we electrocuted we were obliged to get a higher-priced aid—a rather more accomplished Jack Ketch. But not so the trolley. Its machinery was so purely and elementarily automatic—so in a nutshell and within the control of the faintest pressure—that the material out of which drivers and conductors were made was worked over in a day into electric motormen, who, instead of a wilder found a far more tractable and manageable horse—one that went without goad, reins, or word of command; one that needed not to be put in or out or changed for shorter or longer routes. Furthermore, the new steed not only guided but regulated himself, thus dispensing with a switchman; and a horse that not only hauls, but obligingly lights and heats the cars as well. Switchmen are dispensed with by the simplest of expedients at the busiest junctions; the simple placing of an insulated rail in a track, and of disconnecting a current supplied by the car passing over it, being found to throw and replace a switch with absolutely infallible accuracy. And, again, this docile horse will not only do its own work, but anybody else's; for it has been found that where two trolley lines cross, and an accident to one withdraws its power, the power used by the other will leap over into the unoccupied wires of the disabled road and operate them both. Against such figures as these the railways will not attempt to compete, but will struggle on, meeting their fixed charges when they can, and striving to keep down their daily deficits by reorganization committees, and ciphering on the backs of old envelopes instead of writing pads! †

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* Of collateral economies, it is not improbable, for example, that insurance companies, chartered to handle electric risks alone, will make their appearance, nor will they find themselves without an exceedingly profitable investment area.

† A general order to this effect was sent out from the president's office of the Delaware, Lackawanna and Western Railroad a few months since.

But, summary as the above statements appear, these are only the secondary and mechanical effects of this insidious little humming bee—the trolley. The heavier and costlier revolution lies behind its operation and even behind its construction. The legal status of the trolley is that of a street railway. To construct the railway (and it may yet become convenient to adopt the English word "tramway," and apply hereafter arbitrarily the two, making the word *Railway* signify the great lines operated by steam, while the word *Tramway* signifies all lines operated by other traction systems), first of all, that slow-moving branch of the common law which we call "eminent domain" must be invoked with all its paraphernalia; and, of all large bodies, this power of the State, this "eminent domain," moves far the slowest. The jealousy with which it is guarded by legislatures, the reluctance with which it is authorized, the ten thousand and one commissions, boards, and councils which watch with sleepless eyes its control and its administration by the devoted railway company, are as harassing as they are beyond escape. A paternal Interstate Commerce Commission pre-empts the railway situation and pours out three or four octavo volumes a year of rules and regulations. Then the boards of railway commissioners of forty sovereign States take a hand apiece and issue each as many more pandects, edicts, decisions, restrictions, and findings again! Next the boards of aldermen of cities intervene with their ordinances and committees of investigation; and, when there are no boards of aldermen, the county supervisors, "boards of chosen freeholders," town committees, and what not gather around; and no authority, however brief or minute, but has its word in railway operation which, like Mr. Haggard's She, "must be obeyed!" Not only must all these be maintained sooner or later by taxes on the earnings of the railway, with liberal subsidies paid on the nail, but each and all of these are to be supported and placated with "passes"; courtesied to and consulted at every step; salaried, subsidized, and placated, too—for the sole purpose of making laws, rules, to restrict and never to benefit: to curtail but never to enlarge the earning powers of the long-suffering railway. For who ever heard of a law, rule, edict, or ordinance *in behalf of* a railway company—to bless and not to ban? And even courts, which construe a railway to be a quasi-public corporation, are most vigorous in denying it any public right (except, perhaps, the right to be bled and mulcted by everybody). But not so and such is the primal legal career of the blithe little trolley! Not only does it harness an invisible horse who works for no board and no salary, but the greater part of all this accumulated espionage and control is escaped. The "eminent domain" which it enjoys comes to it through the minor powers of annoyance and interference.

It takes its franchises by consent or by ordinance of the lesser municipal corporations above enumerated—the aldermen, the supervisor, the adjoining proprietors; who, lesser in place, are also lesser in appetite and cormorant capabilities. It escapes all but the local "heeler" and "striker." It needs no private funds or private pass-books; no discretionary accounts, except for the smaller appetites. Then, too, when the percentage of accident occurs, the losses are smaller and the damages more minute. The million-dollar disaster and the bankrupting cataclysm are impossibilities to them. Whether the trolley will always escape, as it appears at present to have escaped, the writer for the public press, who at every accident knows just what should have been done to avoid it, just wherein the corporation was criminal or criminally negligent, parsimonious, greedy of gain as estimating income beyond human life or limb, and so on, remains for demonstration. But for the present the trolley's strength, like a woman's, is in her weakness. She sings along her delicate wires, overcoming every obstacle, legal, natural, mechanical, temporal, and practical, dodging every expense, and, best of all, gathers in the ready nickels of everybody and his wife, while her laborious sister, the railway, must pose and turn and make rebates and special rates and ransack the catalogue of inducements if haply she may capture the more infrequent quarters and halves and dollars. With all these, it would seem to be at least common fairness on the part of the cadet of the transportation family to let her elder sister remain monopolist of long-distance traveling and freight transportation which makes her to live. But no! This ambitious young lady has already for long been flirting with freight problems, and has actually projected, incorporated, and capitalized lines ("systems" she probably has already learned to call them) between great centers like New York, Baltimore, and Washington, the carrying of mails and doubtless of our high-priced legislators (which latter will demand the vestibule, the buffet, and parlor and slumber cars, with all that these imply).

The truth is that the trolley is the coming parallel of the railway as to everything in the catalogue. Not even the protests of a nation could keep her off the sacred soil of Gettysburg. She goes where she will. She has even—if the newspapers are veracious—been "held up" in true railway style. Indeed, I foresee nothing that the trolley can not do and nothing that she will not attempt.

With her ambition, however, will come certain disabilities. When she crosses State lines and becomes of interstate dignity, she must not expect immunity from that terrible pigeonholer of freight schedules at Washington, our old mother antic the Interstate Commerce Commission, and that terrible "long and short haul" bugaboo which has already wrecked one of our most ma-

jestic American railway systems * for the benefit of its alien parallel, and which has precipitated three other vast plants into the miseries of receiverships! Will she who has come so swiftly into potent plutocracy, who pays dividends and fills pockets of all concerned, fall at last, as most men and women fall, by her own ambition and insatiate pride of power? Perhaps she can climb over the Interstate Commerce Commission and State boards of railway Solons above enumerated as deftly as she surmounts grades and laughs at incorporation and locating expenses! Let us hope, for her sake, that she does so. But possibly she can not expect, after dissolving the street railway, the narrow-gauge railway, the elevated railway, and all the other tramway devices except her own, to go scot-free of congresses and of State legislatures that sit nine months in every year to make new laws for this law-prolific United States.

It seems hard indeed to believe that the trolley, with all its easy dodging of expenses, can do much more for shippers than the railway has accomplished. In spite of tributes demanded, the American railway has reduced freights again to where they stood before the Interstate Commerce Commission sent them up, so that our railways now carry for an average of one dollar and twenty-two cents a ton, as against an average of two dollars and two cents for the rest of the world.†

The above are a few considerations which lie on the surface of the present enormous development of an invention which had hardly been born at all, but it had leaped like Minerva, adult and armored, from the alleged front of Jove. It may almost be said that it came in obedience to a reluctant summons which was only uttered after almost every other conceivable form of rapid transit had been tried, retried, rejected, and tried over again! In the city of New York, for example (to take the most crowded spot on two continents, where business urgencies of every conceivable character are cramped between waterways upon a narrow island), almost all the varieties of tramway transportation played at leap-frog with each other for years before the trolley came! The history is a curious one, and will bear repeating. But the most curious thing about it is, after all, the long and slow mental processes by which New York capitalists—after sinking hundreds of millions of dollars in building railways across trackless forests and frozen mountains and over unpopulated prairies—arrived at

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* This railway, as it happens, was chartered not by any State, but by the United States, and surely the nation has a right to wreck its own railway by its own laws if it sees fit.

† The actual figures are to-day in Europe: Germany, $1.22; Austria, $2.10; Belgium, $1.54; Denmark, $2.76; France, $2.14; Italy, $2.40; Luxemburg, $1.92; Norway, $3; Holland, $1.52; Roumania, $2.64; Russia, $2.32; Finland, $1.98; Switzerland, $3.36.

the proposition that the place to build a railway was where the people to ride on it lived! right at home in their own packed and overcrowded city!

Surely the history of cheap interstreet transportation in New York has been a veritable whirligig. The archaic hackney coach, then the lumbering old Knickerbocker stages, the driver of each a true Tony Veller, and then the tardy appearance of a street-car line or two on the extreme avenues east and west, as if the old impetus which settled the city along its water fronts must first be consulted in land passenger transportation: and then, as horse-car lines began to appear nearer the spinal center of the city, an effort for a choice of passengers. As who does not remember when the old red Third Avenue cars bore the titles of those departed localities—Yorkville and Harlem (as forgotten now as Greenwich or Chelsea or Strawberry Hill); or, when one could read on certain of the yellow sides of the lumbering Sixth Avenue cars, "Colored people allowed to ride in this car"; and how Broadway, the best and cream of all thoroughfares for traffic lines, was left for a generation to "stages" of lighter models and better lines than the old Knickerbockers, but still as clumsy and lumbering as they could well be made; and how, when the "Gilbert" elevated road ran one day, carrying all who came to demonstrate its safety and speed, New-Yorkers woke up next morning to find these familiar old hulks a thing of the past! (We wise ones know how many of them are still waiting to carry us precariously from some local station to some modern hamlet in the Jersey foothills, perhaps, but we never mention it!)

It is rather a remarkable fact that the very first elevated railway ever proposed to be built in the city of New York (in 1867 or 1868) was intended to be operated by the same contrivance as, thirty years later, was to be adopted by the costliest street surface railway plant in the world! This first tramway, as everybody remembers, the Greenwich Street, or one-legged road, was built on pillars shaped like a letter Y, the rails being on the top of the two arms, while between them, over sunken wheels, traveled a continuous cable operated by steam power generated in stations built in pits dug under the street corners at considerable intervals along the line. These plants were failures, and after a few passenger loads were taken off the cars in ladders, the proprietors gave it up and sold the road for old iron to the highest bidder. This old one-legged road stood where it was, however, the purchasers either defaulting or allowing their purchase to remain unmoved. It was the later success of the "Gilbert" elevated railway which stimulated another company to acquire ultimately this old one-legged road and rebuild it after the Gilbert pattern, thus bringing it into the same system as it now remains. Meanwhile, upon the completion of the Gil-

bert elevated railway, a panic seized the street railway companies. They did not disappear in a night as the stages did, but they one and all began building the small "bobtail" cars—now happily, in New York city at least, illegal—which ran without a conductor, the passenger on entering being exhorted by signs at every turn to put his money in a box, first asking the driver to supply him with change up to two dollars, if necessary, in an envelope, while Providence took care of the horses. The Sixth Avenue line went further and constructed a couple of enormous two-story cars, which it ran up and down its Sixth Avenue line, to claim the air above as well as the earth beneath, and so to make the Gilbert elevated railway and its constructors trespassers. The present writer remembers well the ridicule this move excited, and how a daily illustrated newspaper (the only daily which in those days dared to print a picture) published a picture of one of these huge arks with the second story lettered in capitals, "Law offices of ——, —— & ——!" (being the then firm of attorneys which represented the Sixth Avenue Railway in its fight with the elevated road, and was supposed to have advised the futile demonstration). The laugh was still louder at the Sixth Avenue surface line, however, when it developed that the "Gilbert" elevated, from Carmine Street to Central Park, called for a track elevation on Sixth Avenue which actually cleared by a few feet the highest point of the "double decker" or two-story cars which they had built to assert their title *a cœlo ad orcum!* (a right which, while undoubtedly inhering in the owner of a fee, may perhaps be questionable as accompanying a street-car franchise, especially in a city where the people and not the city own the streets)! Well, the elevated railways remained. Not only did they not decrease the revenues of the surface roads, but the surface roads were obliged to build more cars! Human beings are queer freight! And it was about an equation of the long-distance passenger who rode to the Battery, or the passenger on the lesser routes who in a day or two grew tired of climbing stairways and took the surface roads in preference! The marvelous growth of the city did the rest. No doubt the Sixth Avenue surface road wished that it had the million dollars it had spent in fighting the elevated railway back in its pocket. And now, not only are there scores of surface roads in New York city which feel no inconvenience from the elevated railroads, but there is actually another stage line, while trolley lines are being projected without number to parallel the surface roads, the elevated roads are projecting extensions, and there is at least one subway railway which is reaching out for capital. But what would be a subway except another conduit along which the trolley should string its local wires?

Nor will this adventurer, before which everything succumbs,

rest here. Prior to its advent, wise men were predicting the disappearance of the waterways, since, however economical, they might not be made economical of that costliest of all commodities —of "time"! Just as the inland canal was about to die of superannuation, the trolley has come to its relief. To apply to the canal a circuited instead of a simple overhead wire is a trifling matter, and along it the canal-boat pole ends will yet trundle, until the lazy barges will perhaps rival in bustle the trolley car on land. It may, I think, be confidently expected that, as one resultant of the supersedure of the invisible agency of electricity applied to transportation, considerable and important changes in the law of employed and employer and of negligence will almost immediately become necessary and will attract the attention of the higher courts. Just as the introduction of steam caused important modifications of the rigid and often cruel rules that the employee accepted the risk of his employment, while the employer was quit of responsibility for the negligence (as to each other) of employees; by the corollary that employers must act in touch with scientific improvement, and provide the best and safest implement of service to date: so the utilization of electricity will doubtless add the further qualification that employers must exercise due care in the selection of employees, familiar as nearly as possible with the laws of this new, constant, and invisible force. And it is equally probable that there will be considerable modulation in the assessment of what is or what is not contributory negligence, inasmuch as the peril of casualty by electric operation is and must be for a long time to come peril from an unseen source. Perhaps we shall see a revival of the old legal doctrine of overruling necessity or unavoidable accident ("act of God," as the old lawyers called it), the benefit of which of late years has been refused absolutely to the railway companies. In actions against railway companies for the last quarter of a century it has been permitted to the immediate beneficiaries of an enterprise of a quasi public nature to amerce a corporation merely because, through an inevitable accident, a few persons were killed, when many millions were carried with safety, speed, and comfort, thus imposing upon innocent corporations burdensome restrictions and conditions which hamper the exercise of their independent judgment and sound discretion in matters which virtually affect the public welfare as well as industrial and commercial progress. And it certainly is to the credit of these corporations that such procedure has not induced them to lower rather than to advance either their charges or their efforts in behalf of absolute safety. Whether casual operation of some electric principle or corollary as yet undiscovered—the change in charging power of a plant by reason of some atmospheric condition, some rise or fall of the barometer or of the thermometer—

will be held to be gross negligence, to be responded for in damages on the part of a common carrier who operates his plant by electricity, remains to be seen. With all its advantages and economies even the trolley can not hope to escape all the penalties of success.

To sum it all up, there has suddenly and silently burst upon us an enormous economic agent, and one which, by cheapening the facilities not only of capitalists and manufacturers, but of the least and poorest of consumers, is actually and practically solving those social and agrarian problems which within a few years had threatened serious upheaval in the body politic. With the trolley competing in the field against the railway (selected by the communist as the solid and material symbol of arbitrary power which he should burn and dilapidate and destroy, to assert his popular rights), who shall say that a relief has not come; who shall say but that the railway, with diminished dividends and a divided patronage indeed, may have received from an unexpected quarter immunity from the peril-destroying forces and the hostility of the masses, and at last enjoy its meager surplus of profits over fixed charges, pay roll and maintenance disbursements, in something like peace! Meanwhile the people have been passed from the tender mercies of the larger to those of the smaller capitalists—from the reign of King Log, as it were, to the reign of King Stork. Whether a time will come when our paternal Government will be urged to seize the trolleys and license every one who would operate his own conveyances upon them, remains to be seen. Possibly to the railway-haters the advent of the trolley has come both as a revelation and an extinguisher! At any rate it has brought them the cheap transportation for which they worried, without the expense of building their own railway coaches, and so a revelation in solving their difficulties with unexpected rapidity. But has it also silenced them? They can not demand that Government seize the railways without seizing the tramways. But have they been emancipated, or only had their masters changed? Who shall guess whether the twentieth-century trolley company will not be as remorseless a tyrant as the poor superseded railway company was alleged to have been in its days of dominant usefulness and prosperity?

FROM the circumstances attending the discovery of argen, the *Revue Scientifique* draws the lesson that notwithstanding the precision of science, and in spite of all the brilliant discoveries that have been made, there are very simple facts of which we know nothing, and which we may live by the side of for a long time, blind to them, because we have not learned to see them.

SOME OF THE "OUTLIERS" AMONG BIRDS.

By R. W. SHUFELDT, M. D.

AS in all other departments of biology, the classification of birds was not placed upon a rational basis until midsummer of the year 1858. It was at that time that Darwin and Wallace demonstrated the principles of the law of organic evolution, and gave to the world of science their views upon it and the results of their labors. Prior to their day, when a new form of bird came to the hands of the ornithologist, he considered his duty done, in so far as classification was concerned, after he had generically and specifically christened it, placed it in the family and order where it apparently belonged, and, finally, published its description. Species were thought to be immutable, and consequently the questions of morphology, affinity, and geographical distribution meant little or nothing. If the bird was a duck, with the ducks it went; if a sparrow, then with the sparrows, and so on. Ever and anon, however, a bird form would come to hand that could not be fit with exactness into any of the set and prescribed groups. When this was the case, one author would, for given reasons of his own, place it in this genus, family, and order; while another, for reasons apparently quite as good, would array it elsewhere. Thus these perplexing species were, by one ornithologist or another, tossed about from group to group, and there was no unanimity of opinion as to where they really did belong. This is not at all surprising when we come to consider the views of creation and of Nature that prevailed in the early part of the present century. It was thought by many that birds were created for the admiration of man, and when they sang they sang for man's amusement, and in glorification of their creator. Some very curious notions were entertained in regard to the meager examples of fossil birds known in those days, and the causes for the extinction of existing species were often considered to be "beyond the scope of human reason."

All this and many other crude ideas upon the subject were completely revolutionized when the laws of evolution came to be known. With it came the most remarkable revelation, and the entire science of ornithology passed, as it were, through a transformation scene, and came at once to be regarded from an entirely different point of view. "Classification," as Newton has said, "assumed a wholly different aspect. It had up to that time been little more than a shuffling of cards, the ingenious arrangement of counters in a pretty pattern. Henceforward it was to be the serious study of the workings of Nature in producing the beings we see around us from beings more or less unlike them, that had

existed in bygone ages, and had been the parents of a varied and varying offspring—our fellow-creatures of to-day."

"Classification for the first time was something more than the expression of a fancy. Not that it had not also its imaginative side. Men's minds began to figure to themselves the original type of some well-marked genus or family of birds. They could even discern dimly some generalized stock whence had descended whole groups that now differed strangely in habits and appearance—their discernment aided, may be, by some isolated form which yet retained undeniable traces of a primitive structure. More dimly still, visions of what the first bird may have been like could be reasonably entertained; and passing even to a higher antiquity, the reptilian parent, whence all birds have sprung, was brought within reach of man's consciousness."

When all this came to pass it was those very isolated forms—the so-called "outliers" among birds—to which Prof. Newton alludes in the last paragraph, that then came to be regarded with a peculiar interest by the scientific ornithologist; and, although at the present writing there is by no means a unanimity of opinion as to the position many of them occupy in the system, they nevertheless at once threw a powerful light upon the whole field of ornithology. Ornithotomists everywhere, the world over, carefully investigated their anatomical structure, and groups of birds long thought to be widely separated were seen to be, through these forms, more or less nearly related to each other, and the fact as a whole was demonstrated beyond all cavil that the class *Aves* had arisen from primitive reptilian stock.

Without further dwelling upon this phase of the subject, we will say here that it is the object of the present article to call attention to some of the more prominent species of birds that, to a greater or less extent, are considered to represent these "outliers" of the class. Although hardly to be regarded as belonging among them, the very interesting group of forms that we commonly designate among them as the "ostrich group" are important, inasmuch as through them we are enabled, by the aid of many fossil and subfossil types, to trace birds directly back to some of their reptilian stock. Among the existing ostrichlike types we have the *Apteryx* or *kiwi*, of New Zealand, a bird now supposed by some of our best authorities to have kinship with the rails. Then there are the emeus and cassowaries, rhea, or the South American representative of the ostriches, and, lastly, the true ostriches themselves.*

* The great moas (*Dinornis*) of New Zealand are now extinct, though we have their remains in plenty. This is the case also with the huge *Æpyornis* of Madagascar, the *Gastornis*, the *Struthiolithus* of lower Russia, and the curious fossils found in the Siwalik rocks of

Technically, the common African ostrich is known as *Struthio camelus*, and so the ostrichlike birds, as a group, have come to be spoken of as the "struthious types," or those with "struthious characters." Again, the group as a whole has been designated as the *Ratitæ*, which primarily has reference to the fact that the breastbone or sternum in any one of them lacks a *keel*, and so is "raftlike" as compared with a sternum possessing the character.* With but one or two exceptions, all the rest of existing birds have a more or less well-developed median keel on their sterna, and as the *Carinatæ* they form the second great division of the class *Aves*. Carina is the Latin word meaning "a keel," hence the name for the group. To this keel are attached the *pectoral muscles*, which are so essential to the power of flight.

Linking together the ratite and carinate avian groups, we have an interesting subgroup of birds known as the tinamous.† In 1827 L'Herminier thought that the nearest kin of the tinamous among the carinate birds were the rails (*Rallidæ*). They are South American and Mexican types, and about fifty species of them are known, and systematists have consigned these to some nine or ten genera. All these forms have a general external resemblance to each other, and, as many observers have noted, to those birds we call "partridges." The largest tinamous are about the size of our "prairie chickens," and the smallest about the size of the least of our "quails." They are fine eating; fly pretty well, but are foolish and easily captured. Some of them have but three toes on either foot, others four, and all lay wonderfully handsome eggs. These latter may be of various shades of green, blue, pink, or orange, varying with the species, but in all they have highly burnished shells resembling porcelain or brilliantly polished metal. Little is as yet known of their habits.

Sharpe speaks of the tinamous as "struthious partridges," and Hudson claims that some of their "habits are thoroughly partridgelike,"‡ and if they lead in the direction of the gallinaceous

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India, which are also of birds which were of this group. All of these, both existing and fossil, are or were flightless birds, and the African ostrich, no doubt, the most specialized of any of them. According to Cope, there was a gigantic ostrichlike bird that lived in Texas and New Mexico during the Eocene time (*Diatryma*). It was double the size of an ordinary ostrich. The largest moa, *Dinornis giganteus*, was nearly ten feet high.

* It is probable that all the early ancestors of birds were flightless, and consequently all had *keelless sterna*, except such forms as *Ichthyornis*, and, no doubt, its predecessors were ratite birds, in the sense that they had non-carinate breastbones.

† These birds have deep keels to their sterna, but at the same time possess so many struthious characters in their organizations that they have been designated by Huxley as the *Dromæognathæ*—the genus *Dromæus* containing the emeu—and emeus and tinamous have the structure of the palate much the same.

‡ Nowadays most scientists refer to the tinamous as the *Crypturi*, from the fact that their tails are concealed by the coverts (Gr. *krupto*, I conceal, and *oura*, the tail).

types, the student will there be confronted with at least two families, the exact position of either of which has more or less puzzled the ornithologist—I refer to the megapodes * and those curious little quail-like birds the hemipodes or "button quails." The former leave their eggs to be hatched without incubation, simply burying them in the ground as many reptiles do, or heaping over them a mound composed of leaves, earth, and other materials. There are several species and genera, and the chicks of all are highly developed at birth.† Again, these gallinaceous types, or the "fowls" or "chicken types," ‡ including as they do everything after the fowl order, as turkeys, pheasants, quails, peacocks, and a perfect host of related kin, are beautifully linked with the pigeons # through the true intermediate forms—the sand grouse. ‖

The sand grouse are small, columbo-partridge forms given to remarkable erratic migrations over certain parts of Europe and Asia. Related to the pigeons we have the extinct dodo, and the nearly extinct "tooth-billed pigeon" of the Samoan Islands (*Didunculus strigirostris*). Other birds possessing galline affinities are the well-known curassows,^ and they in their general appearance somewhat remind us of the curious "hoactzin," ◊ one of the veriest "outliers" among birds in existence.

Even at the present writing, avian taxonomers are by no means agreed upon the question of the exact relationships of this bird. Buffon placed it among the curassows, while Gmelin and others arrayed it with the pheasants. ‡ Early in this century Illiger created for it the genus it now occupies, since which time it has received the closest possible attention from ornithotomists in various parts of the world. ‡

Opisthocomus has a size about equal to the chachalaca of our Texan border, and is extremely remarkable in its anatomy, its appearance, its nesting, and its habits. It is found in tropical South America, and but the one species of it is at present known.

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* *Megapodiidæ.*

† Huxley made an independent group for the hemipodes (*Turnicomorphæ*), but other authors still retain them with the galline birds as the *Turnicidæ*. The first-named great authority is probably correct in his position in this matter, or, if retained among the gallinaceous types, they are at least entitled to superfamily rank.

‡ *Gallinæ.*

‖ *Pterocles*, *Syrrhaptes*, to *Geophapes.*

◊ *Opisthocomus cristatus.*

\# *Columbæ.*

^ *Craces.*

‡ *Phasianus.*

‡ According to Newton, who, referring to Huxley's and Garrod's opinion, "*Opisthocomus* must have left the parent stem very shortly before the true *Gallinæ* first appeared, and at about the same time as the independent pedigree of the *Cuculidæ* and *Musophagidæ* commenced, these two groups being, he believed [Garrod], very closely related, and *Opisthocomus* serving to fill the gap between them." This quotation is from Newton's A Dictionary of Birds, a work now passing through the press. The figure of the hoactzin herewith presented, and drawn by the present writer, is also from the same excellent work.

The head of the hoactzin is ornamented with a semipendent crest composed of rather long, loose, yellowish feathers, as shown in the figure below. Below, the body is of a dull chestnut, while above it is olive splashed with white. Its large tail is conspicuously tipped with yellow, while its wings are short and rounded.

These birds congregate in loose companies in the undergrowth found upon the banks of streams and sloughs. Here they are

FIG. 1.—THE HOACTZIN (*O. cristatus*).

easily approached, inasmuch as they are weak fliers and seldom take to wing. They are believed to be polygamous, and it is known that in the manner of their nesting and the appearance of their eggs they strongly remind us of the gallinules and rails. This is a curious circumstance, for it falls into line with another gallinuline character. The claws on the indicial digits of young gallinules are pretty well developed—so much so that they can use them to help crawl out of their nests with, by catching on to twigs, and so forth, in their way and neighborhood. These claw joints are even better developed in the hoactzin, where in the young they are more or less functional. *Opisthocomus* lives upon fruits, leaves, etc. "Its voice is a harsh, grating hiss, and it makes the noise when alarmed, all the individuals sibilating as they fly heavily away from tree to tree when disturbed by passing canoes" (Bates). In British Guiana it is called the "stink bird," from the disagreeable odor it has, and which, according to Newton, Deville likens to that of a cow house. No fossil forms of opisthocomine birds are known.

In studying the group of rail-forms and their kin we meet with many interesting types.* This great rail group appears to be connected with or linked to the pygopodous birds or divers † by two genera of very interesting and as yet little known birds. These are *Heliornis* and *Podica* of the family *Heliornithidæ*, and commonly known as "finfeet." Very little is known of their anatomy, and absolutely nothing of their eggs and nidification.‡

New Zealand, which furnishes us with so many remarkable types, has another genus leading off from the rails. These are the "ocydromes," # curious birds with perfect wings yet incapable

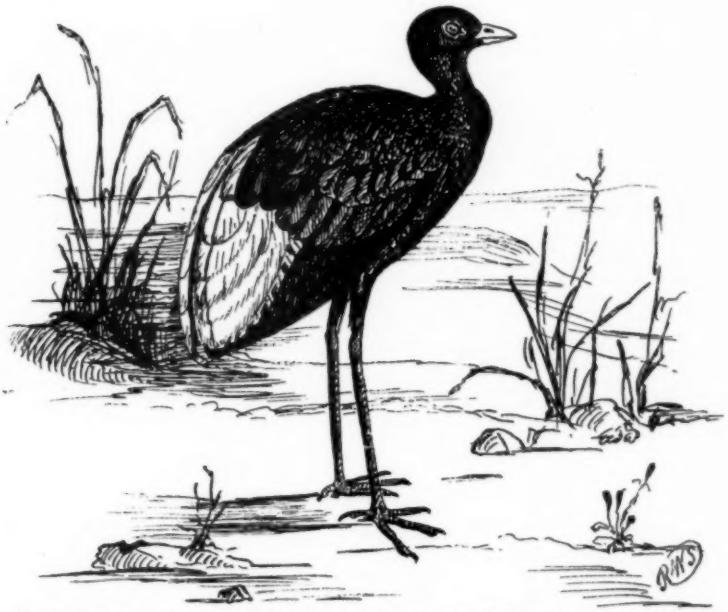

FIG. 2.—THE TRUMPETER (*Psophia leucoptera*). By the author, after Mitchell.

of flight. They are doomed to speedy extinction, and their anatomy and life history stand sadly in need of careful working up.

Another great center of bird life is seen in the plover-snipe group, and some important types link it as "outliers" with various other groups. For instance, in the first place, we have that

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* Our room here will not permit of more than to name some of these, and the student will do well to look into the history of that peculiar genus of exaggerated gallinules known as *Notornis*, as *N. mantelli*, and its fossil relative *Aptornis*, described by Owen, and both from New Zealand. *Porphyrio* and the remarkable genus *Tribonyx* of Australia are still others to be especially noted. They all belong to the gallinuline series of subpartial rail outliers.

† *Pygopodes.*

‡ Prince Maximilian of Wied claims to have shot a male *H. fulica* that had under its wings two new-hatched, naked young. This species occurs from Guatemala to Paraguay, while *Podica* is an African genus.

Ocydromus.

curious, generalized type, the *Dromas ardeola*, that web-footed, long-legged, black and white bird found on the shores and some of the islands of the Indian Ocean. At different times ornithologists have placed this form not only in various families, but in various orders. It has even been associated with the terns, and Sharpe has said it "is in habits a plover, in many points of structure larine [gull], but it burrows in the sand and lays a white egg, like that of a petrel—surely a combination of characters which demand that it shall have a separate rank as the representative of a definite suborder." British ornithologists call it the "cavalier," and place it near the stilts.

Again, we have the "pratincoles," all of the single genus *Glareola*, which are curious little ploverlike birds which have a flight resembling that of the swallows, and, like them, they feed upon the wing. There are nine or ten species of these, being found in Europe, Asia, Africa, and even Australia. They are distinguished for their trim build and marked delicacy in the coloration of their plumage. They nest upon the ground.* With the gull group, the plovers are beautifully linked by those very types of outliers, the sheathbills of the genus *Chionis*. Among the limicoline birds their nearest allies are seen to be the oyster catchers,† while their structure goes to show that, besides the gulls, they have affinities with a number of other groups. Sheathbills are of great interest to the ornithologist, as they are undoubtedly the descendants of very ancient and generalized types. There are at present only two species of them known—the one, *C. minor*, from the Kerguelen Islands, and the other, *C. alba*, from some of the islands of the antarctic seas. In life they somewhat resemble pigeons, and both species are pure white in plumage, while they receive their English name from the little saddle of horn ensheathing the base of the upper part of the bill. Numbers of their eggs have been taken, and they are said to resemble those of a plover. *Chionis* lives upon shellfish and certain sea weeds, and some authorities aver that they have been known to eat the eggs of other birds. Unanimity of opinion among naturalists as to their systematic position as yet by no means exists, and a thorough examination of their anatomy is still a thing much to be desired.‡

Returning once more to the neighborhood of the rails and

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* Some of our best systematists believe they connect the plovers (*Limicolæ*) with the cranes—that is, the true *Charadrii* through the coursers, the thickknees (*Œdicnemi*), and the bustards (*Otis*).

† *Hæmatopus.*

‡ As other avian outliers, and in some ways related to the sheathbills, we have those curious South American forms belonging to the genera *Thinocoris* and *Attagis* of the family *Thinocoridæ*. Our space will only permit of our mentioning their names here.

cranes, we meet with some very remarkable birds—forms that attract the attention of anatomists and ornithologists all over the world. Some of these birds are as yet but very imperfectly known either in the matter of their habits or their morphology. Conspicuous among these stand the trumpeters (*Psophia*) of South America, of which some seven species have been described (see Fig. 2), and all referred to the family *Psophiidæ*. They get their name from the loud and peculiar note they utter—a power associated with the singular structure of the windpipe in the male. *Psophia* appears to be related to the fowls, the rails, and the

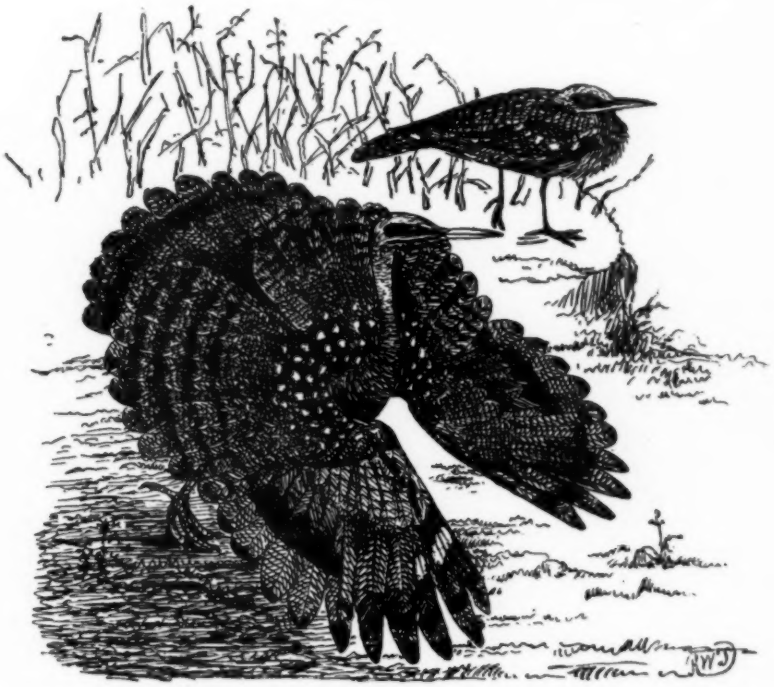

FIG. 3.—THE SUN BITTERN (*Eurypyga helias*). By the author, after Newton.

cranes, and may be a subspecialized descendant of an ancient generalized group, to which the last two may also be traced back. The species vary in size and color, the best-known form being *P. crepitans* of Guiana, which is the "*oiseau trompette*" of the French and the "*trompetero*" of the Spaniards. Big as a small turkey in body, it has longer legs and neck and a beautiful plumage, and even its legs are said to be of a "bright pea green."

These birds are noted for forming in captivity the strongest attachment to man as well as to the domesticated fowls and animals of the barnyard. Some remarkable stories are told by travelers and others in this connection. Although these birds have

been known since the middle of the last century, we are still quite ignorant of their habits in Nature, and their nidification and a great deal of their anatomy.

Right here I would invite attention to another peculiar bird, one which we have in the United States, it being confined to the peninsula of Florida. This is the "limpkin" (*Aramus*), a most perfect "go-between," connecting the rails and the cranes. To American ornithologists and others the bird is well known, and it no doubt is indirectly related to *Psophia*. The limpkin has also been found in the West Indies, the Atlantic coast of Central America, and elsewhere.*

We have next to touch upon two genera of birds that are generally recognized to stand among the most conspicuous outliers to be found in the entire range of the science of ornithology. These are the sun bitterns of South America and the kagu of New Caledonia (see Figs. 3 and 4).† If we take as example the better known of the two species of sun bitterns—*E. helias*, the one shown in our figure—it is seen to be a bird about the size of a willet, with a wonderfully variegated plumage, composed of different shades of brown, black, gray, and white, the whole being arranged and distributed so as to form a pattern quite as *bizarre* as that of a whip-poor-will. Very little has been recorded of the habits of the sun bittern, it merely having been stated that it resorts to the undergrowth found along the muddy banks of sluggish streams, where it feeds upon insects and small fishes.

Newton, who has observed it in captivity, at the gardens of the Zoölogical Society of London, says: "It soon becomes tame, and has several times made its nest and reared its young." It has a plaintive, piping note, and "it ordinarily walks with slow and precise steps, keeping its body in a horizontal position, but at times, when excited, it will go through a series of fantastic performances, spreading its broad wings and tail so as to display their beautiful markings." These sun bitterns were known fully three quarters of a century or more to science before anything at all akin to them was found; but when the island of New Caledonia became colonized, a bird there discovered, and nowhere else, at last furnished an ally. This was the kagu, mentioned above, now described by ornithologists as *Rhinochetus jubatus*. Externally the kagu bears but little resemblance to a sun bittern,

* Madagascar, from her avifaunæ, also gives us a fine example of an outlier, a bird known to science as *Mesites variegatus*—a most peculiar type, to which, further on, I shall briefly refer again.

† Of the sun bitterns there are two species (*Eurypyga helias* and *E. major*), and probably of all existing birds none have so puzzled the systemist with respect to their position in the class. They have in early times been referred to the herons, to the rails, and even to the snipes!

though its internal structure, which has been carefully examined, proves the relationship (see Fig. 4). Considerably larger than *Eurypyga*, it has its head ornamented by a hanging crest of long and soft feathers. Both its legs, which are rather long, and its beak are of a livid red color. Its ample wings are marked

FIG. 4.—THE KAGU (*Rhinochetus jubatus*). Drawn by the author after Newton's figure.

something after the pattern seen in the sun bittern, while its chief body color is a pale slate, shading lighter below. Numerous transverse bars embellish the tail, and these markings, though far less distinct, are seen on the wing coverts also. Ordinarily it is a very passive bird, standing motionless for several minutes at a time, when it will step off briskly for a short distance, only to again assume its attitude of rest. This is by no means, however, the invariable behavior of this extraordinary bird, for when aroused by excitement it will even quite outdo a sun bittern in its extravagant and fantastic "show-off." Holding one of its wings or the extremity of its tail in the most remarkable manner, it will violently spin about in giddy dance, the like of which is never performed by any other known member of the class *Aves*. Unfortunately, this extremely interesting type, it is now said, is becoming rapidly exterminated.*

* It is not at all unlikely but that *Mesites*, the sun bitterns, and the kagu all sprang from some common, generalized, ancestral type long ages extinct, and that all the other host of allies, save the three just mentioned, coming from the same common stock, have also long since died out. Forbes seems to think that "the Malagash *Mesites* is perhaps

Once more in South America we meet with still another oddity among birds—the very prince of outliers—I refer to the far-famed seriema (*Dicholophus cristatus*) (see Fig. 5), a form that has puzzled the best of taxonomers since the middle of the seventeenth century, and even we moderns are as yet by no means agreed upon its exact affinities. With the digestive apparatus of a heron, with an external resemblance to the secretary bird (Fig. 6), with other points in its structure hinting at an alliance with the bustards (*Otis*), or peradventure with some of the plovers, and with habits distinctly its own, it is a fact hardly to be wondered at that the classifiers of birds have at various times placed it with

FIG. 5.—THE SERIEMA (*Dicholophus cristatus*). Copied by the author from Newton's figure.

great certainty in divers orders, families, or of other sections of the class *Aves*. It is, however, safe to say that the seriema has descended with but little modification from some very ancient type, and one that thrived, perhaps, even before a number of our present groups of birds came to be differentiated.

There is a fine living specimen of this bird in the National Zoölogical Gardens of Washington, where the writer has frequently studied it. In body it is about the size of a small turkey, but owing to its long legs and neck it has a height, when stand-

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more nearly related to the New Caledonian *Rhinochetus* than to the neotropical *Eurypyga*." Remarkable indeed are some of the interrelationships of birds.

ing, of over two feet. We are at first struck with the peculiar crest of vertical feathers at the base of the upper bill, and this latter being a bright red, and its large and handsome eyes of a clear yellow, the bird has a very animated mien, which is in no way lessened by its stately carriage. The eyes are surrounded by a pale green or bluish skin, while in its general plumage the seriema is a slaty gray, shading off beneath to a soiled white. On the throat, neck, and sides the feathers are loose and long, and are variegated by fine, irregularly transverse lines. The wings and tail are darker and mottled, while the legs are of a pinkish red. The home of this bird are the elevated plains of Brazil, where, in the high grass of those regions, the traveler not infrequently meets with it. Upon being approached it lowers its body and rapidly skulks away, and, unless the observer be mounted and take after it, it rarely can be induced to take to wing. It lives upon a variety of small animals, as snakes, lizards, and the like, and also eats certain insects, berries, and land snails. Instead of building its nest upon the ground, as one would naturally be led to suppose, it constructs it in the dense undergrowth of bushes, or even some six or seven feet above the ground in a tree. Its two eggs are said to resemble those of some of the crakes or land rails, and the down-covered young long remain in the nest after being hatched.*

We have said above that the seriema bore a general resemblance to the secretary bird. Now this latter is a well-known type, and is itself a true "outlier" of the class which inhabits certain parts of Africa (see Fig. 6). It derives its vernacular name from the fact that it possesses pairs of long, black feathers, which hang loosely from the back of the head and the neck, resembling, in the eyes of some of its describers, the quill stuck above the ear of a clerk. These feathers, when the bird is excited, are capable of erection and dilatation, giving their possessor at such times, an aspect of great fierceness. Standing some four feet in height, and with its raptorial-appearing head, the secretary bird, for all the world, looks like some kind of a falcon on stilts. Its general plumage is a slate blue with black wings. The tail is tipped with white, but what is more peculiar about it is that the middle pairs of feathers are greatly elongated, and give to the bird a very singular appearance.

Living chiefly upon the ground, over which they can run with considerable speed, they nevertheless build their great massive nests in bushes or trees, and deposit therein their two spotted

* Farther south, or in the Argentine Republic, we meet with another bird—the *Chunga burmeisteri*—which is undoubtedly a near ally of the seriema, and has been, by anatomists, but generically separated from it.

eggs; and, as in the case of the seriema, the young remain in the nest for a great length of time, being quite helpless at three or four months of age. Many of them have been reared as pets, and in some localities are useful in destroying vermin about the prem-

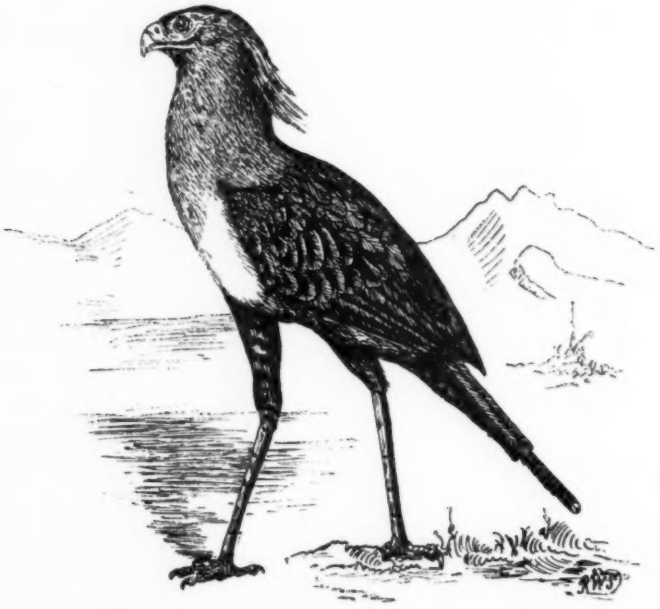

FIG. 6.—THE SECRETARY BIRD (*Gypogeranus serpentarius*).

ises. *Gypogeranus* lives chiefly upon reptiles and insects, and in nature will kill and devour the most venomous species of snakes. A great deal has been written about this last-named habit, and it is the one which has given the bird its popular notoriety. When it meets a big snake of the most venomous variety it will at once advance upon it with stately strides and commence the attack. It will strike the reptile with its knobbed wings and kick forward at it with its feet, until its victim is completely worn out by its fruitless attempts to withstand such an onset, whereupon the merciless victor pounces upon it, crushes its head with a blow from its powerful beak, and at once proceeds to devour its prey. These heronlike falcons are distributed over the greater part of Africa.*

Speaking of the herons, and while we are still in Africa, I desire to call attention to two other strange outliers, both of which are found in that country.

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* They doubtless represent a type which, little modified in time, has descended from some generalized ancestor, long since extinct, and from which not only the *Accipitres* (falcons and their kin), the storks, and herons have been derived, but also the seriema. *Gypogeranus* should be retained in the suborder *Accipitres* as a superfamily—*Gypogeranoidea*.

The first to be noticed is that singular bird known as the hammerhead, a heronlike form about as big as an average-sized bittern, which derives its name from the fancied resemblance of its head to a hammer. This only holds true, however, when its otherwise erectile crest is lowered so as to be in a line with its beak (see Fig. 7). It has been known to science since 1760, when Brisson described it, it being the *Scopus umbretta* of ornithology, and ranges over the greater part of the African continent. In plumage it is of a dingy brown with purplish reflections, while a series of blackish bars mark its tail across. Inactive by day, it is lively enough as night approaches, at which latter time, it is said, it gives itself up to a behavior of a very remarkable order. According to Sharpe, its nest is "a structure of great bulk, with chambers inside, built of branches and twigs and five or six feet in diameter, capable of bearing the weight of a man." This nest has a roof to it and is carefully lined with clay, the entrance being

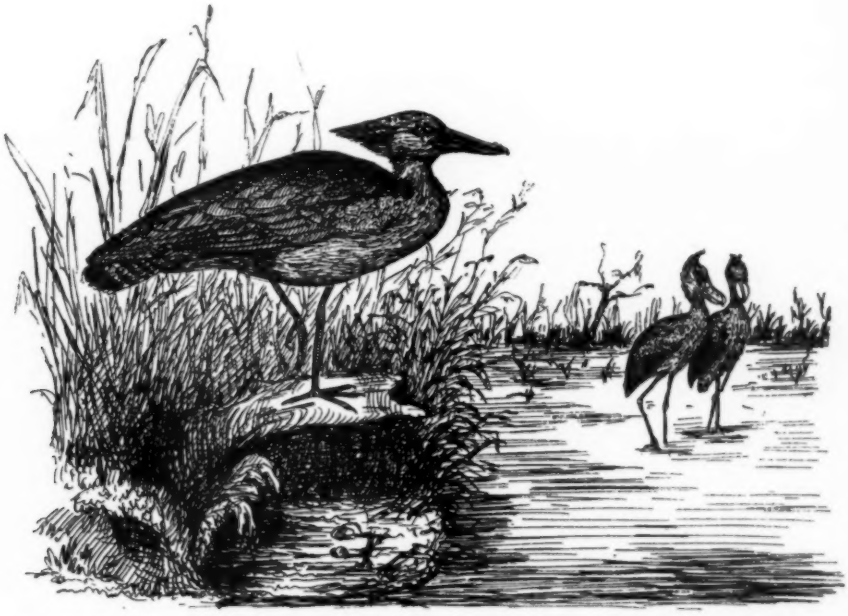

FIG. 7.—THE HAMMERHEAD (*Scopus umbretta*), WITH A PAIR OF SHOEBILLS IN THE DISTANCE (*B. rex*).

at the side. *Scopus* is known to lay white eggs, but up to the present writing the nestling has not been described. Recently the bird has been found in the island of Madagascar.

One other remarkable African outlier is the famous *Balæniceps rex*, known to English travelers as the "shoebill," a storklike heron. A pair of these birds is shown in the distance in Fig. 7 of the present article, and the whole of this figure, exe-

cuted by the writer, is adapted from two drawings given us by Newton; and this distinguished authority has said that "in singularity of aspect few birds surpass *Balæniceps*, with its gaunt gray figure, some five feet in height, its large head surmounted by a little curled tuft, the scowling expression of its eyes, and its huge bill in form not unlike a whale's head—this last suggesting its generic name—but tipped with a formidable hook." These birds lay white eggs with faint markings upon them in an ordinary nest built in the high sedge in the near vicinity of the water. Before leaving this the young are fed by the parents for some time, as in the case of other heronlike types.

Flamingoes (*Phœnicopterus*) are other birds that formerly much exercised the avian taxonomer, and they were variously classified until Huxley and other anatomists clearly demonstrated that they should be awarded a group to themselves, and that they connected the ibises on the one hand with the anserine fowls (ducks, swans, geese, etc.) on the other, standing immediately between these two groups. Not so easy, however, has it been to decide upon the relationships of another most singular bird—that is, the screamer (*Palamedea cornuta*, Fig. 8) of Guiana and the valley of the Amazon—and it may with truth be said that its position in the system is as yet by no means fully understood. That in some strange way it is related to the duck group (*Anseres*) there seems now to be no question, but with what other main assemblages of birds there is a very considerable degree of doubt entertained. This form is as big as a small brant goose, and is noted for its very noisy screams, which make the very air resound when uttered. Either of its wings are armed with two sharp spurs, and on the crown of its head is reared a slender "horn," some three inches in length. Below it is white, while the rest of its general plumage is of a blackish gray, and its toes are very long for the size of the bird. Another strange thing about it is that its skin is separated from the muscles by an air-filled cellular tissue, which gives rise to a crackling sound when the bird is handled, as in the case of certain gannets and cormorants. Screamers are abundant in some localities, where they live in pairs, especially in the marshy districts. They feed upon grain and aquatic herbs. A closely related genus is represented by the "crested screamer" (*Chauna chavaria*) of the swamps and sloughs of the lower Brazils and Paraguay, where it is known to the inhabitants as the "chaka." Not so large as its near ally and lacking its "horn," which latter is replaced by a hanging tuft of feathers, this species is as fully interesting to the ornithologist. It has considerable more white in its plumage, the face and throat being entirely so, while below it is more or less shaded with dusky. A black ring encircles the neck. Linnæus

thought this bird to be a jacana (Fig. 8), in which he was entirely wrong, as the jacanas are now known to stand as a family—the *Jacanidæ*—connecting the rails with the snipe-plover group (*Limicolæ*), with the closer affinity with the latter. Young chakas are frequently reared by the natives from the nest and employed as guards in the poultry yards, a task performed by them with marked success, armed as they are with the spurs upon their wings. They in Nature build a light nest of rushes, often in the water in the shallowest parts of the lagoons where they resort, and in this they lay some half a dozen buffy-white eggs. Nestling chakas are

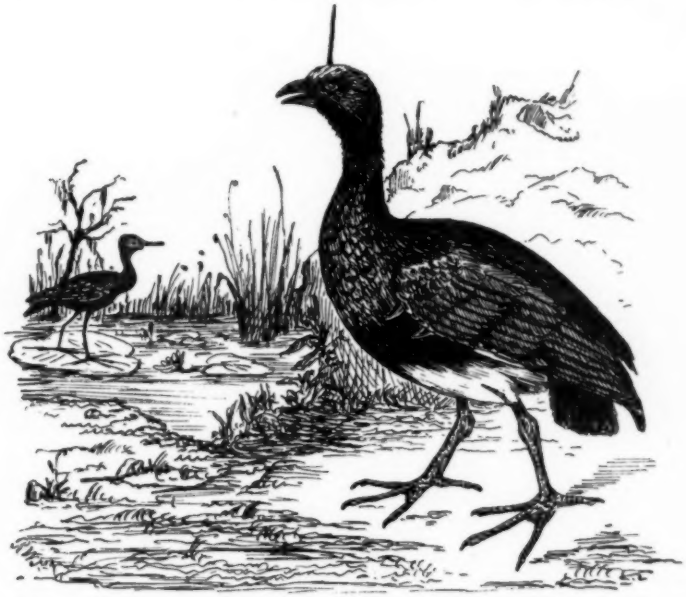

FIG. 8.—THE SCREAMER (*Palamedea cornuta*), WITH A JACANA IN THE NEAR BACKGROUND. Drawn by the author.

covered with a clay-colored down, which is probably also true of the young of *P. cornuta*. These birds—that is, the crested screamers—are given at times to rising to great heights in the air, where they soar in circles, ever and anon uttering their piercing cries of "chaka!" "chaka!" "chaka!" and when a number of them are thus engaged it offers a sight not likely to be forgotten by the observer.*

Passing on next to the parrots,† we find them to be a wonder-

* A darker-plumaged bird of this genus is also found in Central America (*C. derbiana*), which, in common with the others, has the same peculiar emphysematous condition of the skin. Grouped as a family, they are known as the *Palamedeidæ* of some and the *Anhimidæ* of others (Sharpe), and this family should be still further distinguished from other groups of birds by placing it apart in another of its own with at least subordinal rank.

† *Psittaci.*

fully compact group with apparently no very close allies, unless it be the raptores,* as has been suggested by some of their describers. They furnish us, however, with at least one very curious bird, and that is the kakapo of New Zealand (*Stringops habroptilus*), also known as the "owl parrot" or "ground parrot." This survivor of the primitive parrot stock is but another important type that appears to be doomed to early extermination, and that, too, unfortunately, before a thorough monograph upon its morphology and life history have been furnished by science. Most large museums are amply supplied with skins of the kakapo, and a dozen or more specimens have been transported to England alive and studied. But all this is but a very small part of what yet remains to be known of the species. *Stringops* is nocturnal in habits, almost entirely so, and feeds only toward dark, when it will issue forth from its hiding place under rock or root of tree to seek for the seeds and fruits upon which it lives. It also eats leaves, twigs, bits of roots, and even grass, moss, or other plants. Some of the flight muscles and the keel of the sternum are aborted in this parrot, so its powers of flight about amount to *nil*. It spends most of its time upon the ground, and goes up into trees only by climbing. Many of the introduced predaceous animals of the country are its enemies, and to them must be added the greatest destroyer of animal life of them all—man. This is one of the largest of the parrots, and it derives some protection from its plumage, which is of an earthy green, freckled and finely zigzagged over with snuff brown, with longitudinal dashes here and there of straw yellow. It has a powerful beak like a macaw, which it most efficiently uses. About the face the feathers are long and stringy, and so arranged as to remind one at once of a strigine physiognomy. It is an intelligent as well as an affectionate bird in captivity, but lacks the characteristic longevity of the group to which it belongs.† The owls,‡ which are more or less remotely allied to the goatsuckers* rather than to the true raptorial birds,‖ are in some strange way connected through that peculiar strigine nightjar—the guacharo or oilbird of northern South America and the island of Trinidad.△ This great goatsucker is a little larger than our barn owl, with a mottled plumage after the order of the whip-poor-will, only with more brown in it, and is in habit quite as nocturnal as either one of them. In immense numbers it resorts to caverns, coming out in noisy array only at dark to seek the nuts and fruits which constitute its food. *Steatornis* breeds by the hundreds in the vast

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* *Accipitres.*
‡ *Striges.*
‖ *Accipitres.*
† No doubt it should occupy a family by itself, as the *Stringopsidæ.*
* *Caprimulgi.*
△ *Steatornis caripensis.*

gloomy caves to which it resorts, laying three or four white eggs in a shallow clay nest. The young are overlaid with quantities of fat, and are collected by the natives for the oil they afford therefrom. This is an extensive and interesting industry, upon which much has been written.*

We have now passed into an extensive group of birds generally alluded to by ornithologists as the "picarian assemblage," that not only includes the goatsuckers, of which we have just been speaking, but also many other families.† Some of the relationships of the representatives of these groups are by no means as yet understood fully; many of them are interrelated; others exhibit characters which link them with another great assemblage of birds—that is, the *passerine* group, or the *Passeres*. This is the case with the woodpeckers, for example, and also with the swifts, which latter are related to the swallows (*Hirundinidæ*). All this with equal truth applies to the *Passeres*, of which we have just spoken, and to which the swallows belong. Quite a number of the families among the passerine birds, however, have been very carefully examined, and ornithologists the world over are agreed as to their affinities, while on the other hand we are at our wits' end in regard to the determination of the allies of some of the passerine outliers. A few of the more puzzling forms of these can now be briefly introduced. The little "American dipper" (*Cinclus*) of the Rocky Mountain region is one of these, a bird not much larger than a bluebird, which is completely aquatic, even to the extent of hunting for its food under water.‡

FIG. 9.—THE HUIA (*Heteralocha*). Upper figure, female; lower, male. Shufeldt, after Newton.

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* As a type this form is the sole representative of a distinct family—the *Steatornithidæ*.

† As, for example, the cuckoos (*Coccyges*), the rollers (*Coraciæ*), the kingfishers (*Alcedines*), the hornbills (*Bucerotes*), the todies (*Todi*), the trogons (*Trogones*), the swifts (*Cypseli*), the woodpeckers (*Pici*), the bee-eaters (*Meropes*), the hummingbirds (*Trochili*), the motmots (*Momoti*), and hosts of others and all their various allies.

‡ *Cinclus* has by some been placed with the thrushes (*Turdidæ*), by others with the wrens (*Troglodytidæ*), while the present writer, after examining it osteologically, believes it to be related to the genus *Siurus*. Several of this last-named genus are "water thrushes," and the ovenbird (*S. aurocapillus*) at least builds a covered nest with a side entrance, as does the dipper (*Cinclus*).

New Zealand, that land of oddities in Nature, adds another to our list in this place. I refer to the species called the *huia* by the native Maoris. Owing to the fact that the bill is entirely different in the two sexes, the male and female have been referred to two distinct species (Fig. 9). Newton says: "According to the personal observation of Sir W. Buller, who enters at length on the natural history of the huia (Birds of New Zealand, second edition, vol. i, pp. 7–17), its favorite food is the grub of a timber-boring beetle, and the male bird with his short, stout bill attacks the more decayed portions of the wood and chisels out his prey, while the female with her long, slender bill probes the holes in the sounder part, the hardness of which resists his weapon; or when he, having removed the decayed portion, is unable to reach the grub, the female comes to his aid and accomplishes what he has failed to do. The huia is entirely a forest bird, and is doubtless one of those doomed to extinction, though at present it seems to maintain its existence. Except a white terminal band on the tail, the whole plumage in both sexes is black, with green metallic gloss; the bill is ivory white, and the large rounded wattles at the gape are of a rich orange" (Dictionary of Birds, part ii, p. 438).

Before concluding I will refer to one or two more of the puzzling outliers to be found among the passerine birds, and none of them have exercised the ornithologist more than the curious little "scrub birds" of Australia. Shortly after these were first made known to science they were simply regarded as belonging to the Australian warblers,* but after their internal structure was examined it was found that they constituted quite a distinct family, to which now the two species known have been relegated.† So far as I am at present aware, neither the nest nor the eggs nor even the female of either of the species of this family are known, and the only birds supposed to be allied to them are the famous "lyre birds" (see Fig. 10), also of Australia. These last are so curious, both in their external appearance and in their internal structure, that they have by various systematists and describers been assigned to all sorts of positions and considered to have been allied to widely separated groups. Originally thought to be a "pheasant," and subsequently a "bird of paradise," and by Huxley placed in a group by itself, the relationships of the *Menura* were by no means unraveled until Newton took it in hand in 1875, more than three quarters of a century after its discovery, and placed it in a distinct family—the *Menuridæ* of the great passerine group. He also declared its alliance with the "scrub birds," for which he created another family, the *Atrichiidæ*, as

* *Maluridæ.* † *Atrichia clamosa, A. rufescens,* family *Atrichiidæ.*

above pointed out. The present writer shares this opinion with him.

The appearance of the Superb lyre bird is well shown in Fig. 10, and the adults attain a size about equal to that of our ruffed grouse (*Bonasa*), or rather less. It is only the adult male that possesses the extraordinarily developed tail shown in the drawing, although that appendage is quite lengthy in the female, and contains sixteen feathers. These birds have a smoky-brown plumage, loose in texture, which inclines to chestnut on the throat and tail

FIG. 10.—THE LYRE BIRD (*Menura superba*). Drawn by the author.

coverts. Their wings are rounded and short, while their legs and feet are strongly developed. They spend most of their time on the ground, have a loud call note, but, owing to their great shyness and the rocky, broken country they inhabit, are only taken with difficulty. They go in pairs, and Gould says they are most successfully hunted by treeing them with dogs. The bird is four years old before its gorgeous tail is fully matured, but after that it is molted and renewed every season. Its food consists of land snails and various kinds of insects, and its nest is a massive structure usually built on the ground, and has an entrance at the side. *Menura* lays but one egg, that is large for the size of the bird. It is blotched with purplish brown on a ground color of a pur-

plish gray. Some of its habits are very extraordinary, while no doubt it has many others as yet unknown. Captivity is but illy borne by it, and it soon perishes in that state, and indeed it is said the species is on the highroad to extinction in its native land. No doubt this will be effected even before we are fully acquainted with all its habits and ways, and man will be responsible for sweeping off the face of the earth forever one of the loveliest forms that has ever graced it or ever will. Dismal indeed will be the forests and Nature's wilds when each and all such graceful creatures, such forms of life and beauty, are completely exterminated. Such work is going on in every quarter of the globe as I pen these lines, and with very marked rapidity. Still, this is but fate and the natural order of things; and we must believe that in the centuries to come the Earth will see the day when man's descendants will be her only inhabitants, with perhaps the merest remnant of any other forms of vertebrate life, and these completely subjected to his will and sway. How much the more, then, does it devolve upon us to fully record in all particulars the biology of those forms now in existence in our midst, and especially those types, the outliers—the connecting links—in all departments of Nature so essential to its understanding, and in order that our heirs and descendants may the more completely comprehend the history of the origin of organic life upon the face of the globe and the manifold mysteries of its evolution.

REGARDING the manlike apes as our nearest relatives in the animal world, Dr. R. Lydekker observes, in Knowledge, that the relationship is to be spoken of as one of cousins and not of ancestry; and that we should at once free ourselves from any idea that there is a vestige of direct ancestral kinship between these creatures and ourselves. Such relation as does exist is of a comparatively distant kind; and the common ancestor must have lived ages before the mammoth roamed over the plains and valleys of England, since at that time man was as distinctly differentiated from the apes as he is in the present century. Whether this "missing link" will ever turn up, or in what country it is most likely to have lived, are questions impossible to answer; but from the extreme rarity with which fossil remains of manlike apes are found in countries where they are known to have existed for long ages, and from the probability that the distributional area of the aforesaid "link" was extremely limited, not much hope can be given that the researches of paleontologists will ever be rewarded by such a find.

M. MOISSAN has found, in his electrical furnace, that quite as distinct chemical actions go on in molten cast iron as those with which the chemist has long been familiar in aqueous solutions at ordinary temperatures. The actions are often very complex, because of the faculty which iron has of retaining many compounds as impurities. The author has precipitated carbon and carbide of iron in fusions by means of boron and silicon; all these substances behaving in the liquid iron precisely as the substances with which we deal in a similar manner behave in water.

STUDIES OF CHILDHOOD.

VII.—LATER PROGRESS IN LANGUAGE.

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IN a previous paper I traced some of the earlier steps in the child's acquisition of language. In the present study we may follow him in his later and more ambitious linguistic efforts.

The transition to this higher plane is marked by the use of the complete form of thought or sentence.

At first, as already pointed out, there is no sentence structure. The child begins to talk by using single words. His speech is monepic.

These words consist of substantives, such as "mamma," "nurse," "milk," and so forth; a few adjectives as "hot," "nice," "good"; a still smaller number of adverbial signs, as "ta-ta," "away" or "over," "down," "up"; and one or two verb forms, apparently imperatives, as "go." The exact order in which these appear, and the proportion between the different classes of constituents at a particular age, say two and a half or three, appear to vary greatly. Words descriptive of actions, though very few at first, appear to grow numerous in a later stage.*

In speaking of these words as substantives, adjectives, and so forth, I am merely adopting a convenient mode of description. We must not suppose that the words as used in this simple disjointed talk have their full grammatical value. It is not generally recognized that the single-worded utterance of the child is an abbreviated sentence or "sentence word" analogous to the sentence words found in the lowest known stage of human language. As with the race so with the child, the sentence precedes the word.† Moreover, each of the child's so-called words in his single-worded talk stands for a considerable variety of sentence forms. Thus the words in the child's vocabulary which we call substantives do duty for verbs and so forth. As Preyer remarks, "chair" (*Stuhl*) means "There is no chair"; "I want to be put in the chair"; "The chair is broken," and so-forth. In like manner "dow" (down) may mean "The spoon has fallen down."‡ The particular shade of meaning intended is indicated by intonation and gesture.

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* For lists of vocabularies and analysis of these compositions see Preyer, *op. cit.*, p. 361. Tracy, Psychology of Childhood, p. 76 ff.

† Cf. Romanes, *op. cit.*, p. 296 ff.

‡ See Preyer, *op. cit.*, p. 361; Romanes, *op. cit.*, p. 296 ff.

This sentence construction begins with a certain timidity. The age at which such conversation is first observed varies greatly. It seems in most cases to be somewhere about the twenty-first month; yet a friend of mine, a professor of literature, tells me that his boy formed simple sentences as early as fifteen months. We commonly have at first two-worded sentences formed by two words in apposition. These may be what we should call an adjective added to and qualifying a substantive, as in the simple utterance of the child C——, "Big bir" (bird), or the exclamation "Papa no" (papa's nose); or they may arise by a combination of substantives, as in the sentence given by Tracy, "Papa cacker"—i. e., "Papa has crackers"; and one quoted by Preyer, "Auntie cake" (German, "Danna Kuha"—i. e., "*Tante Kuche*") for "Auntie has given me cake"; and in a somewhat different example of a compound sentence also given by Preyer, "Home milk" (German, "Haim Mimi"), which interpreted is "I want to go home and have milk." In the case of one child about the age of twenty-three months most of the sentences were composed of two words, one of which corresponded to our verb in the imperative, as "go!"

Little by little the learner manages longer sentences, economizing his resources to the utmost, troubling nothing about inflections or the insertion of prepositions, so as to indicate precise relations; but leaving his hearer to discover his meaning as best he may; and it is truly wonderful what the child manages to express in this rude fashion. Pollock's little girl in the first essay at sentence-building, recorded at the age of twenty-one months and a half, actually managed a neat antithesis: "Cabs dati, clam clin"—that is to say, "Cabs are dirty, and the perambulator is clean." Preyer's boy, in the beginning of the third year, brought out the following: "Mimi atta teppa papa oi"—that is to say, "Milch atta Teppich Papa fui," which appears to have signified, "The milk is gone, it is on the carpet, and papa said 'Fie.'"

The order of words in these first juxtapositions is noticeable. It frequently differs from what we should suppose to be the natural order. Sometimes the subject follows the predicate, as in an example given by Pollock: "Run away man"—i. e., "The man runs" or "has run away"; and in the still quainter example given by the same writer, "Out-pull-baby 'pecs (spectacles)"—i. e., "Baby pulls or will pull out the spectacles." In like manner the attributive (adjective used as predicate) may precede the subject, as in the examples given by Maillet, "*Jolie la fleur*" (pretty flower), and so on.* Sometimes, again, the object comes

* Quoted by Compayré, L'Evolution intellectuelle et morale de l'Enfant, p. 206.

before the verb, as apparently in the following example given by Miss Shinn: A little girl, delighted at the prospect of going out to see the moon, exclaimed, "Moo'-'ky (sky) baby shee" (see).* Another kind of inversion occurs when more complex experiences are attempted, as in connecting "my" with an adjective. Thus one child said prettily, "Poor my friends." †

These inversions of our familiar order are suggestive. They have some resemblance to the curious order which appears in the spontaneous sign-making of deaf-mutes. Thus a deaf-mute answered the question, Who made God? by saying, "God made nothing"—i. e., "nothing made God." Similarly the deaf-mute Laura Bridgman expressed the petition "Give Laura bread" by the form "Laura bread give." ‡ Such inversions, as we know, are common in certain languages—e. g., Latin. The study of the syntax of child language and of the sign-making of deaf-mutes might suggest that our English order is not the spontaneous or natural order of expression.*

A somewhat similar inversion of what seems to us the proper order appears in the child's first attempts at negation. The child C—— early in his third year expressed the idea that he was not going into the sea thus: "No (his name) go in water, no." Similarly Pollock's child expressed acquiescence in a prohibition in this manner: "Baby have papa (pepper) no," where the "no" followed without a pause. The same order appears in the case of French children: e. g., "Papa non"—i. e., "It is not papa," and seems to be a common if not a universal form of the first half-spontaneous sentence-building. Here, again, we see an analogy to the syntax of deaf-mutes, who appear to append the sign of negation in a similar way: e. g., "Teacher I beat, deceive, scold, no"—i. e., "I must not beat, deceive, scold my teacher." In the use of special signs of affirmation the correspondence seems less close. Thus Pollock's child was wont to emphasize a positive statement in this way: "Es, es (yes, yes), baby's book there." The deaf-mute appears in such cases to append the affirmative sign.

Another closely related characteristic of this early childish sentence-building is the love of antithesis under the form of two balancing statements. Thus a child will often oppose an affirmative to a negative statement as a means of bringing out the full

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* Notes on the Development of a Child, p. 84.

† Canton, The Invisible Playmate, p. 32; who adds that this exactly answers to the form "Good, my lord!"

‡ See Romanes, *op. cit.*, p. 116 f, where other examples may be found.

* The languages of savages appear to differ like those of civilized races in respect of order, the succession substantive, verb, attributive, as in "John is good," appearing alongside of the inverse—e. g., "Good is John," See article L'Importance des Langues Sauvages, Revue Philosophique, 1894, p. 465 ff.

meaning of the former. The boy C——, for example, would say "This a nice bow-wow, not nasty bow-wow." This use of negation by way of contrast or opposition took an odd form in the case of one child, who, at the age of two years and two months, would describe things by negations. Thus an orange was described by saying, "No, 'tisn't apple"; porridge, by saying, "No, 'tisn't bread and milk." It is interesting to note that deaf-mutes proceed in a similar fashion by way of antithetic negative statement. One of these expressed the thought, "I must love and honor my teacher," by the order, "Teacher I beat, deceive, scold, no! I love, honor, yes!" *

These first essays in sentence-building illustrate the skill of the child in eking out its scanty vocabulary by the help of a metaphorical transference of meaning. Taine gives a charming example of this. A little girl of eighteen months had acquired the word "*coucou*" as used by her mother or nurse when playfully hiding behind a door or chair, and the expression "*ça brûle*" as employed to warn her that her dinner was too hot, or that she must put on her hat in the garden to keep off the hot sun. One day, on seeing the sun disappear behind a hill, she exclaimed, "*A bûle coucou.*" †

It is a tremendous moment when the child first tries its hand at inflections, and more especially, in our language, those of verbs. Pollock's child made the attempt, and successfully, at the age of twenty-two months. Such first essays are probably perfectly imitative, the precise form used having been previously heard from others. Hence, while they show a growing thought-power, a differencing of relations of number and time, they do not involve verbal construction proper. This appears as soon as the child carries over his knowledge of particular cases of verbal inflection and applies it to new words. This involves a nascent appreciation of the reason or rule according to which words are modified. The development of this feeling for the general mode of verbal change underlies all the later advance in correct speaking.

While the little explorer in the *terra incognita* of language can proceed safely in this direction up to a certain point, he is apt, as we all know, to stumble now and again; nor is this to be wondered at when we remember the intricacies, the irregularities, which characterize a language like ours. In trying, for example, to manage the preterit of an English verb, he is certain, as indeed is the foreigner, to go wrong. The direction of the errors is often in the transformation of the weak to the strong form; as

* A curious example of negative antithesis is given by Perez, *op. cit.*, p. 196. On other analogies between the syntax of children and deaf-mutes, see Compayré, *op. cit.*, p. 251 f.

† On Intelligence, part i, book i, chaps. ii, vi.

when "screamed" becomes "scram"; "split" (preterit), "splat" or "splut," and so forth. In other cases the child will convert a strong into a weak form, as when Laura Bridgman, like many another child, would say "I eated," "I seed," and so forth.* These differences in the direction of the solecism would probably turn on differences in the word-forms serving as model or precedent which happen to be learned first and to make the strongest impression on the memory.

One thing seems clear here: the child's instinct is to simplify our forms, to get rid of irregularities. This is strikingly illustrated in the use of the heterogeneous assemblage of forms known as the verb "to be." It is really hard on a child to expect him to answer the question, "Are you good now?" by saying, "Yes, I am." He says, of course, "Yes, I are." Perhaps the poor verb "to be" has suffered every kind of violence at the hands of children.† Prof. Max Müller somewhere says that children are the purifiers of language. Would it not be well if they could become its simplifiers also, and give us in place of this heap of dissimilar sounds one good decent verb-form?

Other quaint transformations occur when the child begins to combine words, as when he says, "Am't I?" for "Am I not," after the pattern of "Aren't we?" An even finer linguistic stroke than this is "Bettern't you?" for "Had you not better?" where the child was evidently trying to get in the form "Hadn't you," along with the awkward "better," which seemed to belong to the "had," and solved the problem by treating "better" as the verb, and dropping "had" altogether.

A study of these solecisms, which are nearly always amusing, and sometimes daintily pretty, is useful to mothers and young teachers by way of showing how much hard work, how much of real conjectural inference, enters into children's essays in talking. We ought not to wonder that they now and again slip; rather ought we to wonder that with all the intricacies and pitfalls of our language—this applies, of course, with especial force to the motley, irregular English tongue—they slip so rarely. As a matter of fact, the later and more "correct" talk—which is correct just because there is a large memory-stock of particular word-forms, and consequently a much greater scope for pure uninventive imitation—is much less admirable than the early inventive imitation; for this last not only has the quality of originality, but shows the germ of a truly grammatical feeling for the

* The same double tendency from weak to strong forms, and *vice versa*, see in the list of transformed past participles given by Preyer, *op. cit.*, p. 360.

† See Preyer's account of a German child's liberties with the same verb where we find *gebisst*, *binnst*, and other odd forms, *op. cit.*, p. 438.

general types or norms of the language, so far as this has become familiar.

The English child is not much troubled by inflections of substantives. The pronouns, however, as every mother knows, are apt to cause much heartburning to the little linguist. The mastery of "I" and "you," "me," "mine," etc., forms an epoch in the development of linguistic faculty and of the power of thought which is so closely correlated with these. Hence it will repay a brief inspection.

As is well known, children begin by designating themselves and those whom they address by names, as when they say, "Baby good," "Mamma come." This is described as speaking "in the third person," yet this is not quite accurate, seeing that there is as yet no distinction of person in the child language.

Later, when the little brain grows more cunning and the tongue nimbler, the child introduces differences of person, and uses the pronominal forms "I" or "me," "you," etc. So far as I can ascertain, most children begin to say "me" before they say "you." Yet I have met with one or two apparent exceptions to this rule. Thus the boy C—— certainly seemed to get hold of the form of the second person before that of the first, and the priority of "you" is attested in another case sent to me. It is desirable to get more observations on this point.

To determine the exact date at which an intelligent use of the first person appears is much less easy than it looks. A child is apt at first to use the forms "me" and "you" mechanically—that is, imitating exactly what another says, and so speaking of another person as "I" and of himself as "you." Here it is evident there is no clear proof of the pronominal form. Allowing for these difficulties, it may be said with some degree of confidence that the great transition from "baby" to "I" is wont to take place in favorable cases early in the third year. Thus among the dates assigned by different observers I find twenty-four months and twenty-five months (cases given by Preyer), between twenty-five and twenty-six (Pollock), twenty-seven months (the boy C——). A lady friend tells me that her boy began to use "I" at twenty-four months. In the case of a certain number of precocious children this point is attained at an earlier date. Thus Preyer quotes a case of a child speaking in the first person at twenty months. Schultze gives a case at nineteen months. A friend of mine, a professor of English literature, whose boy showed great precocity at sentence-building, reports that he used the forms "me" and "I" within the sixteenth month. Preyer's boy, on the other hand, who was evidently somewhat slow in lingual development, first used the forms of the first person "to me' (*mir*) at the age of twenty-nine months.

The precise way in which these pronominal forms first appear is very curious. Many children use "me" before "I." Preyer's boy appears to have first used the form "to me" (*mir*). "My," too, is apt to appear among the earliest forms. In such different ways does the child pass to the new and difficult region of pronominal speech.

The meaning of this transition has given rise to much discussion. It is plain, to begin with, that a child can not acquire these forms as he acquires the names "papa," "nurse," by a direct and comparatively mechanical mode of imitation. When he does imitate in this fashion he produces, as we have seen, the absurdity of speaking of himself as "you." Hence during the first year or so of speech he makes no use of these forms. He speaks of himself as "baby" or some equivalent name, others coming down to his level and setting him the example.

The transition seems to be due in part, as I have already pointed out, to a growing self-consciousness, to a clearer singling out of the *ego* or self as the center of thought and activity, and the understanding of the other "persons" in relation to this center. Not that self-consciousness *begins* with the use of "I." The child has, no doubt, a rudimentary self-consciousness when he talks about himself as about any other object; yet the use of the forms "I," "me," may be taken to mark the greater precision of the idea of self as not merely one among a group of things, but as something distinct from and opposed to other things—what we call the subject or *ego*.*

While, however, we may set down this exchange of the proper name for the forms "I" and "me" as due to the spontaneous growth of the child's intelligence, it is possible that education exerts its influence too. It is conjecturable that, as a child's intelligence grows, others in speaking to him tend unknowingly to introduce the forms "I" and "you" more frequently. Yet I am disposed to think that the child commonly takes the lead here. However this be, it is clear that growth of intelligence, involving that of interest in others' words, will lead to a closer attention to these pronominal forms as employed by others. In this way the environment works on the growing mind of the child, stimulating it to direct its thoughts to these subtle relations of the "me and not me," "mine and thine." The more intelligent the environment the greater will be the stimulating influence; hence, in part at least, the difference of age when the new style of speech is attained.

The acquirement of these pronominal forms is a slow and irksome business. At first they are introduced hesitatingly and

* Cf. Study V, January number of this magazine, p. 351.

alongside of the proper name, the child, for example, saying sometimes "baby" or "Ilda," sometimes "I" or "me." In some cases, again, the two forms are used at the same time in opposition, as in the delightful form not unknown in older folk's language, "Hilda, my book." The forms "I" and "me," are, moreover, confined at first to a few expressions, as "I am" "I went," and so forth. The dropping of the old forms, as may be seen by a glance at C——'s lingual jargon and at Preyer's correct diary, is a gradual process.

Quaint solecisms mark the first stages in the use of these pronouns. As in the case of the earlier use of substantives, one and the same form will be used economically for a variety of meanings, as when "me" was used by the boy C—— to do duty for "mine" also, and "us" for "ours." Sometimes new and delightful forms are added, as when the same little experimenter struck out the possessive form "she's."

The perfect and free use of these puzzling forms comes much later. Preyer quotes a case in which a child, Olga, aged four years, would say, "She has made me wet," meaning that she herself had done it. But this perhaps points to that tendency to split up the self into a number of personalities to which reference was made in an earlier chapter.

There is one part of this child's work of learning our language of which I have said hardly anything—viz., the divining of the verbal context, of the meaning we put or try to put into our words. A brief reference to this may well bring this study of childish linguistics to a close.

The least attention to a child in the process of language-learning will show how much of downright hard work goes to the understanding of language. If we are to judge by the effort required, we might say that the child does as much in deciphering his mother tongue as an Oriental scholar in deciphering a system of hieroglyphics. Just think, for example, how many careful comparisons the small child-brain has to carry out—comparisons in the several uses of the word by others in varying circumstances—before he can get anything approaching to a clear idea, answering even to such seemingly simple words as "clean," "old," or "clever." The way in which inquiring children plague us with questions of the form "What does such and such a word mean?" sufficiently shows how much thought-activity goes in the trying to get at meanings. This difficulty, moreover, persists, reappearing in new forms as the child pushes his way onward into the more tangled tracts of the lingual terrane. It is felt, and felt keenly, too, when most of the torments of articulation are over and forgotten. Many of us can remember how certain words haunted us as uncanny forms, into the nature of which we tried hard but in vain to penetrate.

Owing to these difficulties the little learner is always drifting into misunderstanding of words. Such misapprehensions will arise in a passive way by the mere play of association which attaches the word to some features of the particular object or set of circumstances with reference to which the word happens to be used in the child's hearing. In this way, for example, general terms become terribly restricted in range, as when the child supposes that pudding is something made of milk, the church is a building with a spire and a yew tree, that ragged is having no shoes and socks, and so forth. Such a going off the track to side and accidental features seems to be reflected in much of children's quaint misapplications of more difficult words, as when a little boy of six used "consulted" for serious, talking of a thrush as looking consulted, and of people looking "concerned and consulted."

With these losings of the verbal road through associative by-paths may be taken the host of misapprehensions into which children are apt to fall through the ambiguities of our words and expressions, and our short and elliptical modes of speaking. Thus an American child, noting that children were "half price" at a certain show, wanted his mother to get a baby, now that babies were cheap.* With this may be compared the following: Jean Ingelow tells us she can well remember how sad she was made by her father telling her one day after dancing her on his knee that he must put her down, as he "had a bone in his leg."† Much misapprehension arises, too, from our figurative use of language, which the little listener is apt to interpret in a very literal way. It would be worth knowing what odd renderings the child-brain has given to such expressions as "an upright man," "a fish out of water," and the like.

In addition to these comparatively passive misapprehensions there are others which are the outcome of an intellectual effort, the endeavor to penetrate into the mystery of some new and puzzling words or expression. Many of us have had our special horrors, our *bêtes noires* among words, which have tormented us for months and years. I remember how I was plagued by the word "wean," the explanation of which was very properly, no doubt, denied me by the authorities, and by what quaint fancies I tried to fill in a meaning.

As with words, so with whole expressions and sayings. What queer renderings the child-mind has given to Scripture language! Mr. James Payne tells us that he knew a boy who for years sub-

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* Worcester collection, p. 21.

† Cf. the account Goltz gives of the anxiety he felt as a child on hearing that his uvula (*Zapfen*) had fallen down, *op. cit.*, p. 261.

stituted for the words "Hallowed be thy name," "Harold be thy name."* In this and similar cases it is not, as might be supposed, defective hearing—children hear words, as a rule, with great exactness. It is the impulse to give a familiar and significant rendering to what is strange and meaningless.† A friend of mine could recall that when a boy he was accustomed, on hearing the passage, "If I say peradventure the darkness," etc., to insert a pause after "peradventure," apprehending the passage in this wise: "If I say 'Peradventure!' the darkness is." In this way he turned the mysterious "peradventure" into a mystic "Open Sesame," and added a fine touch of romantic color to the passage. My friend's daughter tells me that on hearing the passage "shewing his mercy unto the thousands and visiting the sins of the fathers to the third and fourth generation," she construed the strange word "generation" to mean an immense number like billions, and was thus led to trouble herself about God's seeming to be more cruel than kind.

In some cases, too, where the language is simple enough a child's brain will find our meaning unsuitable and follow a line of interpretation of its own. Mr. Canton relates that his little girl, who knew the lines in Strumpelpeter—

> "The doctor came and shook his head,
> And gave him nasty physic too"—

was told that she would catch a cold, and that she at once replied, "And will the doctor come and shook my head?"‡ It was so much more natural to suppose that when the doctor came and did something this was done on the person of the patient.

There is something of this same desire to get behind words in children's word-play, as we call it, their discovery of odd affinities of verbal sound, and their punning. Though, no doubt, this contains a genuine element of childish fun, it betokens a more serious trait also, a deep interest in word-sounds as such, and a curiosity about their origin and purpose. It is difficult for grown-up people to go back in thought to the attitude of the child-mind toward verbal sounds. Just as children show "the innocence of the eye" in seeing the colors of objects as they are and not as our habits of interpretation tend to make them, so they show an innocence of the ear, catching the intrinsic sensuous qualities of a word or a group of words, in a way which has become impossible for us.

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* In The Illustrated London News, June 30, 1894.

† Of course, defective auditory apprehension may assist in these cases. Goltz gives an example from his own childhood. He took the words "*Namen nennen Dich nicht*" to be "*Namen nenne Dich nicht*," and was sorely puzzled at the idea of bidding a name not to name itself.

‡ The Invisible Playmate, p. 35.

This half-playful, half-serious scrutiny of word-sounds leads to the attempt to find by analysis and analogy a familiar meaning in strange words. For example, a little boy about four years old heard his mother speak of nurse's "neuralgia," from which she had been suffering some time. He therefore exclaimed, "I don't think it's *neu*ralgia, I call it old ralgia." A child called his doll "Shakespeare," because its spearlike legs could be shaken. Another child explained the "master" which he prefixed to his name by saying he was master of his dog. A little girl in her third year called anchovies "ham-chovies," mermaid "worm-maid," whirlwind "world-wind," gnomes "no-mans" (*Un-menschen*), seeming to take pleasure in imparting some familiar element into the strange jumble of word-sound that beset her ear.

This quasi-punning transformation of words is curiously like what may be called folk-derivation, when a word is altered so as to be made to appear significant and suitable for its purpose, as in the oft-quoted form "beef-eater" (corruption of *buffetier*, from *buffet*, sideboard), and in the form "crayfish" (from French *écrevisse* or O. H. German *Krebiz*), where the attempt to suit the form to the thing is still more apparent.* When, for example, a boy calls a holiday a "hollorday," because it is a day "to hollo in," we may say that he is reflecting the process by which peoples alter the forms of words, giving them a perfectly fanciful etymology, so as to make them seem to fit their objects. Some children carry out such transformation and invention of derivation on a large scale, often resorting to pretty myth, as when the butterflies are said to make butter or to eat butter, grasshoppers to give grass, honeysuckles to yield all the honey, and so forth.†

A child will even go further, and, prying into the forms of gender, create an explanatory myth which may dimly reflect the ancient myths of peoples which lay at the root of these distinctions of gender. Thus a little boy, aged five years and three months, who had learned German and Italian, as well as English, was much troubled about the gender of the sun and moon. So he set about myth-making on this wise: "I suppose people‡ think the sun is the husband, the moon is the wife, and all the stars the little children, and Jupiter the maid."

One other characteristic feature in the child's attitude toward words must be touched on, because it is, in a manner, the opposite of the impulse to tamper with words just dealt with. A child is

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* The other form of the word, "crawfish," seems a still more ingenious example of folk etymology.

† These last are taken from a good list of children's punnings in Dr. Stanley Hall's article, The Workings of Children's Minds.

‡ This is, I take it, the majority—viz., Italians and English.

a great stickler for accuracy in the repetition of all familiar word-forms. The zeal of a child in correcting others' language, and the comical errors he will now and again fall into in exercising his pedagogic function, are well known to parents. Sometimes he shows himself the most absurd of pedants. "Shall I read to you out of this book, baby?" asked a mother of her boy, about two years and a half old. "No," replied the infant, "not *out* of *dot* book, but somepy inside of it." The same little stickler for verbal accuracy, when his nurse asked him, "Are you going to build your bricks, baby?" replied solemnly, "We don't build bricks, we make them and then build *with* them." In the notes on the boy C—— we find an example of how jealously the child-mind insists on the *ipsissima verba* in the recounting of his familiar stories.

I have in this essay confined myself to some of the more common and elementary features of the child's linguistic experience. Others present themselves when the reading stage is reached, and the new, strange, stupid-looking word-symbol on the printed page has to do duty for the living sound, which for the child, as we have seen, seems to belong to the object and to share in its life. But this subject, tempting as it is, must be left. And the same must be said of these special difficulties and problems which arise for the child-mind when two or more languages are spoken. This is a branch of child-linguistics which, so far as I know, has never been explored.

THE PERSONAL EQUATION IN HUMAN TRUTH.

By REUBEN POST HALLECK.

WHETHER there is any such entity as absolute truth we leave for the metaphysician to determine. Out of a vast number of factors which may affect truth in general, we here select a few which are to-day deflecting and limiting human truth. There are factors inherent in the self at its present stage of development, or, more broadly speaking, certain psychical laws which man's present nature will not allow him to change or to evade. So long as the present intense struggle for existence continues, so long must the existence of the self be a constant menace to the full truth, and a partial truth is often worse than a lie.

Our own actions do not raise in us the same feelings as similar actions on the part of others. Egoistic emotion is more or less present with all. Egoistic emotion invariably warps the truth. We do a thing, and it seems all right; another does the same thing, and it seems all wrong. A man of high moral ideal found fault with his neighbor for working on Sunday about a suburban

house. The following Sunday men came from the city with a view to purchasing some lots which the moral man was desirous of selling. He took the prospective buyers over the lots with great alacrity, showing the good points. The neighbor reproved the moral man, who became extremely angry. Laborers frequently denounce a trust with great bitterness of feeling, and yet they proceed to form a labor trust with the express purpose of making labor dear and shutting off competition. They refuse to let an outside workman mine coal, except at the risk of his life, although his children may be starving. Do the workmen experience the same feeling of indignation at their own conduct in forming a trust as they do toward other trusts? A woman was one day genuinely indignant because candidates lacking a certain characteristic had been elected members of her club. In less than a week she was trying to secure the admission of a friend who lacked precisely the same quality. No feeling of indignation at her own conduct ruffled that woman's brow this time. We frequently hear it said, "If I were to do as she is doing, how angry she would be!" There is one test which the majority of persons can apply to themselves. They have told another something in confidence, and have felt indignant because he betrayed that confidence. There are very few persons who have not at some one time in their life betrayed a confidential secret to some one else. Amusing as it seems, it is common to hear a person accuse himself of a breach of trust, saying, as he tells a secret, "This was told me in *confidence*." His egoistic emotion will not allow him to say, "I am not worthy of confidence," although he would unhesitatingly draw that conclusion in the case of another. His egoistic emotion prompts him to make the same kind of excuse that a murderer offered for his crime: "A person should expect to be murdered if he keeps so much gold about him." We occasionally hear some one remark, "I know of no person that has a higher ideal for others or a lower one for self."

It is confidently remarked that the egoistic emotions can not warp mathematical truths, for they are inflexible and unerring. Such a statement might do very well in schoolrooms, but it has no place elsewhere. A noted lawyer said: "I have a client who is a plaintiff in a damage suit. Now, a damage, if expressed at all, must be mathematically expressed. My client's damages amount to the sum of two and two, or four. But he can not possibly add his own two and two of damage without making the sum five. The defendant adds this same two and two and makes the sum three. If it were not for the fact that the emotions of self will not allow men to add units correctly, quite a percentage of my practice would be gone. If men were sure that selfish emotion would not prompt another man to take advantage of

them when opportunity offered, a still larger percentage of my practice would be lost."

The undoubted fact that our own acts do not cause in us the same emotions as similar acts on the part of others is one of the strangest psychological truths. This legacy from unevolved man, from the times when brute might was the only right, has been handed down to us. This legacy is still a beam of varying size in every human eye. We shall probably long continue to excuse certain acts of our own and of our friends and to criticise our enemies severely for those same deeds. We see this tendency full-fledged in animals. A big, strong dog will take away a bone from a starving dog. A wealthy railroad president and wealthy directors will plan to wreck a rival road whose bonds and stock may constitute a large proportion of the investments of some orphans. These men would experience intense emotion if any one attempted to steal from a child of theirs. They will steal from the children of others without a qualm. The advance in intelligence has many times served to increase this tendency. Napoleon was a very intelligent man. The promoters of hydra-headed trusts are men of great sagacity. It is nevertheless true that, as a man acquires the habit of reflecting on his own actions, as he by an effort places himself in a neutral position, and from that changed point of view looks at his deeds with another's eyes, as he puts himself in the place of those whom his acts have inconvenienced or wronged, this brute legacy, so destructive of truth, will grow less and less. But only the possessor of a vivid imagination, either natural or acquired, can ever succeed in doing this. Children who are early taught to regard each act from the point of view of those affected by that act are placed in the royal road to overcome this tendency. A successful business man recently said that he did not wish his children thus taught, for such training would put them at a disadvantage in the struggle for existence.

True conceptions are hampered not only by those emotions which are popularly termed peculiarly egoistic, but by all emotion, which a searching investigation shows to rest upon a hidden foundation sunk deep in those feelings which affect the self for weal or woe. All emotion has a twofold aspect in regard to thought and the search for truth. On the one hand, emotion supplies all the interest we feel in any subject, and is thus absolutely necessary for all long-continued, earnest thought; on the other hand, there is thus a deflecting power necessarily at work in the center of every thought. The strong desire to prove a certain theory has led the most honest of men to look at certain facts through colored glasses. It is often dangerous to consult any medical specialist at first, because he will have a tendency to see unmistakable signs of the complaint which he treats. Only those

truths in which we are interested, only those which strike our emotions, are fully operative; others pass us by without influencing our actions. The laws of life declare that those truths in which we have a selfish interest shall be the most numerous of all. Not only the lowest, but the highest of life's truths, the truths of love and immortality, are emotional truths. Such truths are proverbially blind. Cold reason was never responsible for the lofty flights of love, or for the terrible alighting, which so frequently follows, on the hardest of ground. But any truth can never be a full truth to us until we have felt it. If there is such an entity as absolute truth roaming around loose, not affecting human feelings and actions, it might as well not be at large. All talk about veneration for truth in the abstract is merely talk. It is easy to prove this. Take some person whose self is not interested in the subject and talk to him about the truths of an echinoderm, a cephalopod, an amœba, or a series of latent chemical reactions, and notice how soon he becomes bored. Prof. Sully rightly says: "Even the scientific man who shows the speculative feeling in so intense a form is often surprisingly narrow in the range of his intellectual interest. The general or abstract sentiment, a pleasurable interest in all or any new ideas, is in fact a kind of fiction."

We are now brought face to face with another fact. The thought limitations of any human being so circumscribe the truth that we can never be sure that we have the whole truth. Our thinking is principally for the sake of our doing, and that must be definite, concrete, limited. A shoemaker's business renders his conception of the human being a narrow one, and for that reason an unfair one. The shape of the head, the hand, the trunk, may be neglected by him. He may be unacquainted with the relation of the auricles to the ventricles in the heart; he may not know whether the stomach is above or below the diaphragm; he may not be able to distinguish between the sympathetic and the cerebro-spinal nervous system. It is evident that his view of the human body is narrow and unfair. Allow one skillful physician to question another equally skillful, and the first will easily show how narrow and unfair are the ideas of the other. Everything is related directly or indirectly to everything else. No mortal eye can detect all those relations. Some undetected one may be vital, must be vital, to knowing the full truth about anything. Prof. James has well emphasized the fact that the Infinite alone can have a fair, impartial, or fully truthful view of any single thing. The Infinite alone can see all these myriad relations. Every time a man neglects one aspect of a thing he is unfair to it; if he neglects ninety-nine, he is still more unfair. We pick up a book; we notice the type and paper. Do we know all the crude attempts

by means of hieroglyphics to communicate thought? Do we know the history of the first attempts at making type? Do we know all the processes in the manufacture of the type before us? That type is a metal, taken from the mines, perhaps formed in the Devonian or even the Archæan period of geological time. Earth's metals have definite relations to the sun's spectra, to the spectra of the fixed stars, to the spectra of the chaotic nebulæ floating like evening clouds through the starlit depths of space. If we do not know these, we must confess that we understand but little of the relations involved in the production of a book.

We pick up a piece of metal that we call gold. A chemist tells us that we are rash in calling this gold, for he suspects that, if its molecular relations were understood, it would be clearly seen to be nothing but hydrogen. He says that the last analysis would probably show sulphur, iron, lead, oxygen, silver, copper—in fact, all the metals and all the so-called elements—to be one and the same substance with a different molecular arrangement. The physicist says he shall no longer place hard and fast lines of demarcation between heat, light, and electricity. The psychologist has ceased to view perception, memory, thought, emotion, and will as different forces. The metaphysician declares that we might as well stop writing treatises on special subjects, for all the sciences are merely various phases of one great underlying science, though our ignorance has not yet allowed us to see the intimate relations between all, just as the chemist's ignorance has not permitted him to see that gold, silver, and lead are the same substance.

We proceed practically in this way to untie this unpleasant Gordian knot of ignorance. In the case of the book we say: "We shall deliberately disregard those relations which do not vitally concern our immediate selfish interests. Our present aim is to read that novel, and we do not now care how long mankind groped in ignorance, when books were first printed, how the type-metal is prepared, whence it came, or what relations the spectroscope shows it to have in common with the sun, the stars, and the nebulæ."

Considerations like these show us how incomplete is human truth, how one-sided and partial, how trivial and superficial it would seem to a being of complete intelligence. *So long as the struggle for existence continues, so long must human truth develop especially on its selfish side.* Electricity will be investigated along the line of its utility to the self. Engineering skill will construct bridges with vast spans over which trains may roll laden with flour and corn and beef. In justice to the aspirations of the human soul, it may be said that many a one has been forced to expend its energies in routine struggles for bread when that

soul would gladly have devoted its powers toward climbing the steps of a broader and higher truth. The octopian struggle for existence with its deadly tentacles has throttled many a one that would have gladly climbed to loftier heights of truth.

Thus the emotions and the limitations of humanity deflect and narrow truth. There is also another powerful deflecting factor. This is called association or apperception by different schools. Each succeeding truth that comes to the mind is changed by the resultant force of preceding truths. A compass may point exactly north until it is brought near a bar of iron, when the direction of the needle is changed. This iron has an analogy to an idea already existing in the mind. To Turks and South Africans polygamy may not clash with a moral truth, because they have been brought up amid polygamous associations. Had we sprung from such ancestry and been reared in the same way, we should doubtless consider polygamy quite moral. The child of Catholic, Baptist, or Mohammedan parentage will commonly look at religion from the point of view of his early associations. When we hear a person, referring to a certain sect, saying, "I could never have belonged to this or that church," we may know that he would probably have been a Catholic, or Baptist, or a Mohammedan had he been born such. The truths of religion may not change, but our ways of apprehending them are largely determined by association.

Eminent German psychologists have said that we can not think as we will, but we must think as just those associations which happen to be present prescribe. When we come to view such statements as these in the light of what history has recorded, they furnish food for careful reflection. Had we been born in the times of religious persecution, should we not have joined the vast majority who believed in repressing heresy by lighted fagots? When every Christian nation from Scotland to Spain was torturing witches, should we have stood aloof from the councils of the wisest? At one time even the most intelligent in the Southern States were fighting for what early associations had taught the people to regard as the truths of slavery. The North, schooled differently, was fighting on the other side. History shows us that association has ever been a potent factor in our conception of truth, and association is often purely accidental.

All of the judges of the Supreme Court of the United States may be hearing the same testimony in a case, and yet these judges frequently express dissenting opinions, although no selfish end is to be gained by this course. This illustration shows the varying, even accidental, factors in the production of so-called truth. The truths of justice ought not to be less important than other truths, and yet here are judges, each equally desirous of awarding jus-

tice, expressing conflicting opinions from precisely the same data. One part of the testimony will attach itself to some former experience in the case of a certain judge. That testimony may thereby become powerfully swayed by that association, and may therefore assume undue importance. Other testimony may not receive sufficient attention, because there was no associated factor to intensify the impression. A jury is especially exposed to such deflections. If there is a damage suit over injury to a child, any jurymen who have children will be peculiarly sensitive to testimony showing carelessness on the part of the one who occasioned the injury, and peculiarly deaf to testimony establishing the fact that the child's own fault was responsible for the harm. In general, less important truths with a powerful attachment to something in our own experience will completely overshadow those more important with no such association. No one can forecast how many truths will affect certain people until he knows what associated ideas these truths have to contend with.

The association of ideas goes so far as even to affect the way in which we perceive things. A passing bird may be perceived, or, as some people prefer to say, "apperceived," by a lady as an ornament to her bonnet; by a fruit-grower as an insect-killer; by a poet as a songster; by an artist as a fine bit of coloring and form. The housewife may apperceive old rags as something to be thrown away; a rag-picker, as something to be gathered up. A carpenter, walking in a forest, would see the trees as possible sticks of timber. A botanist would notice the shapes of the leaves. A hunter would have an eye for coverts for game. A fisherman would regard the stream flowing through the wood as a good place for trout. An ornithologist would have an ear for the birds. A man's profession can soon be detected by the way he perceives things. The truths of our world are determined by what we see, and *we for the most part see only those things which we can join to something in our own line of experience. All other things do not exist for us. Their truths are not a part of our world.* After we have perceived a thing, the brain probably never returns to its former state. Any new perception will feel the deflecting force of former perceptions. A butcher and a cloth manufacturer perceive a sheep in an entirely different way. If their perceptions have differed, it is impossible for two persons to see a new thing in precisely the same way. It is of the utmost importance for success in life that this truth be fully apprehended. Men succeed in proportion to their fullness of understanding their fellow-men and influencing them. Educated persons ought to expect different men to look at the same thing in different ways, and the intelligent should be constantly prepared to meet such cases. If psychology is to have practical worth, such

truths as these must be emphasized. There will then be less surprise when people quarrel and go to law because they can not see the same thing in the same way. Many a business failure might have been averted had this trouble been adequately known in advance. Where a danger is philosophically foreseen, the risks incident to it may be diminished.

We need constantly to remember that human truth is a variable incomplete entity; that it differs according to whether it is your truth or my truth; that it is subject to the deflections of emotion, at the mercy of the association of ideas and of the education and personal training received in any community at any time.

MANUAL TRAINING.

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PRINCIPAL OF THE NORTHEAST MANUAL TRAINING SCHOOL, PHILADELPHIA.

II.

IT will be remembered by those familiar with biblical lore that when Saul, the son of Kish, went forth in search of his father's asses, he found, instead of these humble animals, a kingdom and a crown. Not every man is so fortunate. Indeed, as we all know, the experience is often reversed. Yet it does fall out from time to time that a very modest journey into the world of thought or action lands one in the midst of wholly unexpected possessions. The Burgomeister of Dessau, patiently gazing at the sun day after day for thirty years, and noting the sun-spots as they waxed and waned, to discover in the end their remarkable periodicity, is a more modern instance. Others might be cited. We go in quest of a given end. We travel a few paces. A chance experiment, an almost random thought, and behold—a new world! It is no miracle sprung full-grown from the womb of the impossible. It is an orderly sequence, the wider prospect which comes from a better point of view.

I have had a somewhat similar experience in this matter of manual training. I came in search of a quiet good; I find a kingdom.

We are inquiring into the inner content of manual training. Let us begin at the beginning—at the mystery of birth. It is a favorite starting point of mine, for life best stands out in all its cosmic relations when I view it as a sublime panorama, watching the human soul as it emerges from the mists of infancy and following it until it sinks below the horizon of the grave. It is a method which has the disadvantage of long prefaces, but perhaps the compensation of clearer conclusions.

A child, then, is born into the world—a puny, screaming, reddish creature—a very fragment of humanity. Were we gods, unacquainted, let us say, with the wheel of birth and death, and did we find ourselves for the first time face to face with infancy, we would see in it but little promise. If we found our infant, like Romulus, suckled at the breast of a she-wolf, and had we no more developed human with whom to compare it, our amazement would fast turn into repulsion. The child would appear a helpless parasite, sucking in the outer world and making no return. The picture would not attract, for it would be devoid of that element, dear alike to gods and men, the element of power. But add now another figure. Let it be the picture of mother and child. It is a picture which for many centuries has claimed the adoration of mankind—an adoration shown as well in its art as in its religion. And back of the art and back of the religion there is, I think, a significance still deeper and still more catholic. The second figure has changed our entire attitude. The helplessness no longer repels. It is seen to be a phase and not of the essence. What the one is, the other may become. We love the child for its sweet promise, and, though we may be disappointed a hundred times, the next-comer is the occasion of renewed hope.

Yet the mystery is not dispelled.

By what divine metamorphosis, we should ask, is this crude, rebellious organism transformed into the likeness of the serene and beautiful mother? We could only answer this self-put question if we stopped and watched the unfolding. What the elfin child of our imagination appeared to be doing the human child in reality does. It drinks in the outer world; and it must do so, for upon this depend its life and its growth. Food and air and light must flow to it from their several sources. They are the material of its body and the stuff of its increase. The faculties must exercise themselves upon the many objects of perception. They must transmit to the brain their corresponding sensations. These are the material of thought and the food which nourishes intelligence. Who the alchemist is—the subtle inner self which transmutes the seemingly dead elements into a living organism and the accumulated sensations into coherent thought—we do not know. Let us call it the human spirit, the sum of human faculty; or, to be brief, the soul. This is, I think, a legitimate use of the word. But the point I want to emphasize is this, that the soul, whatever it may be, whether the cause of the life process or its result, is no creator. It is a living fabric, woven on the warp and woof of cause and effect. It depends for its growth upon the materials of growth. The spinning must cease when there are no more strands to be woven. And so it comes about that souls differ from one another in magnitude. They are stunted, if the material of

growth be limited. They are generous, if the material of growth be plentiful. And by material of growth I mean available material. A dyspeptic organism in the presence of food which it can not assimilate; a feeble brain structure face to face with possible sensations which for it are impossible—these are the victims of a fatal stint. We can set no limit to the power of assimilation. We can see no boundaries to the possibilities of sensation. The unfolding spirit finds itself at the beginning of a road, the end of which lies in infinity.

The distance between the mother and child is very great. Yet it may be traversed, and by one path, that of experience. This is only another way of saying that the child drinks in the outer world. The avidity with which it drinks, the completeness with which it assimilates, these condition its growth. What the one is, the other *may* become. What the one is, the other does not necessarily become. The process of education, conscious and unconscious, formal and informal, the education of daily contact with life, determines the resemblance or divergence.

It would be a serious matter if we allowed the education of the child to proceed without guidance. This would be to lose the profit of our own experience. It is a still more serious matter when we attempt to guide it. I am afraid that with our sophisticated ways we often do things which make life, acting unconsciously, a far better schoolmaster than we, with all our conscious methods.

Have I made myself clear? Have I pointed out with sufficient plainness and sufficient emphasis that men are the children of their own experience; that education is a process by which we enlarge this experience; that the art of teaching lies in the discrimination with which we decide upon the desirability of any possible experience, and the skill with which we bring the selected experience within reach of the child? I have meant to do so, and for a special reason. What to do?—that is one question. How to do it?—that is another. These two lie at the basis of manual training, as they do at the basis of every other scheme of education. The different answers give rise to the different schemes.

In adding manual training to current education, we are called upon to justify both the end and the means. The end must be rational; the means must be adequate. This is a reasonable demand. I am glad to answer for manual training, and to try to tell why we do it. I hope that others will be minded to correct and to complete the answer that I am about to give.

We did it in the first place for a quiet good.

In the face of matter, man seemed so helpless. In taking boys from the home and field and farm, and packing them into school-

houses, we robbed them of much of their natural physical activity, and lessened the education that comes through the senses. There were some compensations. We brought about a certain amount of self-control. We made the boys acquainted with certain facts. We bespoke an interest in the things of the spirit. The humanities made some progress. But the fact remained that in all this we were dealing with the symbols of things rather than with the things themselves. It was observed that our children dwelt in a curious and a somewhat unwholesome world of unreality. It was startling to find, as I once did, a boy of fourteen who had been so persistently taught that the moon shone by reflected light, that he believed the moon to be nothing more than an image of the sun cast on the celestial sphere, much as we throw a sunbeam on the wall. He was greatly surprised at the time of an eclipse to find that the moon was a solid body. It reflected somewhat on the usefulness of geography to find children whose main impression, after a considerable study of the map, was that Pennsylvania was yellow and New Jersey pink, while for some unexplained reason New York was green. Doubtless things have improved since those days, but even now, in the year of grace 1895, the study of child psychology is revealing the fact that large percentages of our school children are ignorant of the most everyday realities of life. These same children can outtalk and out-name their less-schooled elders. They can make a quiet country boy silent and abashed in the presence of their wordy knowledge. But in spite of it all they leave an impression of undesirable helplessness. Now, we are all agreed that, as things stand at present, the school can not be dispensed with. Its benefits are much too substantial. But it can be supplemented, and some at least of these deficiencies corrected. The early motive for the introduction of manual training was precisely this. It was a desire to bring boyhood back into a world of reality through an acquaintance with things. Dexterity in the use of tools, and in the handling of such stubborn facts as wood and clay and metal, was held to be important as a part of this reality. The work went on with earnest singleness of purpose and commands the respect of even those who see in manual training something much deeper than this mere convenience.

This first end was objective. It must always remain valid. An intelligent regard for the conditions imposed by a world of matter is a large element in successful living. No one appreciates this more keenly than your out-and-out transcendentalist. After all, he is our truly practical man. But this quiet good began to expand into something larger when men came to cherish it for a wider motive. To do certain things was useful—to saw and plane and chisel and turn and chip and file. To do them well was more

useful. It was recognized as a part of virtue. It meant not only an ability to accomplish certain practical operations successfully, but it also meant much more than this. It meant the cultivation of character. It meant the growth of patience, of perseverance, and of judgment. It meant the development of the sturdy virtues of self-reliance and self-poise. Manual training came to have an ethical value. I can not do better here than to quote with cordial approval a passage from Mr. Edward Carpenter's Essay on Desirable Mansions:

"Man is made to work with his hands. This is a fact which can not be got over. From this central fact he can not travel far. I don't care whether it be an individual or a class, the life which is far removed from this becomes corrupt, shriveled, and diseased. You may explain it how you like, but it is so. Administrative work has to be done in a nation as well as productive work; but it must be done by men accustomed to manual labor, who have the healthy decision and primitive, authentic judgment which comes of that, else it can not be done well. In the new form of society which is slowly advancing upon us, this will be felt more than now. The higher the position of trust a man occupies, the more will it be thought important that at some period of his life he should have been thoroughly inured to manual work; this not only on account of the physical and moral robustness implied by it, but equally because it will be seen to be impossible for any one without this experience of what is the very flesh and blood of the national life to promote the good health of the nation, or to understand the conditions under which the people live whom he has to serve."

Manual training has thus shown two aspects. It presents itself as a convenience, and as an agent of moral culture. To-day it is entering a new phase, and is expanding into a kingdom. It is doing so through the recognition of its psychological import.

Consider the structure of the human body. It is an organism made up of many complex tissues, of bones, muscles, and nerves. The whole is nourished by blood, manufactured within its own precincts. Special organs and ducts provide a system of sewerage for the prompt disposal of waste. In health, the blood supply is ample, its aëration complete, the renewal of tissue is prompt, the removal of waste is without interruption. Each organ performs its function. We have a healthy human animal—a rare sight. We value it for what it is and for what it can do. The indicated strength must be turned to some account. The well-poised head must display intelligence. A failure in these expectations, and our seemingly perfect human mechanism is a sad disappointment. It is the informing spirit and the disciplined will that make the Apollo admirable. These do not spring like Venus from the

forehead of Jove. They are the children of a slower evolution. Each organ performs its function so perfectly because of the discipline of use, because of the slow discipline of long-continued use. We recognize this in the matter of the actions called physical. We build gymnasiums on this principle, and lay out our athletic grounds accordingly. The runner wants well-developed nerve and muscle, and he wants the habit of rapid action. The champion in every sport needs the human apparatus, the nerve and sinew, and he also needs the habit of prompt exercise. It is the same with the bodily organs and functions. Strong lungs come from deep breathing and the pumping of maximum quantities of air. If we want a strong stomach we must give it work to do. We must eat cheese and nuts and other foods that are hard to digest. It will never do to live on peptones. All this is very obvious. But it is less obvious when we come to speak of the operations of the spirit. Yet the case is quite the same. We need the organ and, through exercise, the well-developed function. Our thinking is connected with molecular changes in the brain and spinal column. It will depend upon these and upon the degree of their organization. But thinking is a complex operation. It may be resolved into simpler elements, into sensations. But even here it no longer suffices to say that these sensations are transmitted to the brain. This language is entirely too general. Their destination may be specifically stated. They go to a particular part of the brain, depending on their nature.

With respect to the outer world, we have but one sense, and that is the sense of touch. All our impressions are tactile. The outer world has for us but one mode of operation, and that is through motion. The organs of sense are attuned to different degrees of motion, and unerringly pick out their own notes. The ear, sensitive enough to the coarse air waves which constitute sound, is utterly deaf to the minute light waves which so easily affect the eye. The ego touches the outer world only at its own bodily extremities. What it comes in contact with is motion. For us, then, the outer world is coextensive with motion, and with only so much motion as we can perceive. The outer world has different dimensions according to the sensitiveness of this power of perception. The motion to which we do not respond is an unseen and unknown world—an undiscovered country. The motion to which we do respond makes up our entire world. It is our universe.

The impressions gathered by the several senses are transmitted to the brain over their appropriate nerve routes. Here at this central station the same exquisite division of labor prevails as at the outlying stations on the circumference. In receiving sensa-

tions, the brain does not act as a whole. It is rather a series of resonance boxes, each box responding to vibrations of particular pitch. The reports of the several senses are all duly pigeonholed. In the same way every outgoing nerve impulse comes from a special center. It is not by a general action of the brain that we carry on our several activities, but by the action of a special part of the brain, depending on the nature of the activity. Any injury to this center, and the activities connected with it are as completely paralyzed as if the whole tissue were destroyed. By so much is a man dead; by so much is his universe curtailed. On the other hand, any increase in the power of these centers, and there comes an increase of life, an expansion of the realized universe.

Power, that is what we are after. Let us keep it always in mind. Let us not be turned off from the main quest, however alluring the side issues. We want the increased power of the human spirit.

Now, power is a result as well as a cause. Intellectual power is the result of a developed brain organism. This development comes through use. Any activity at the circumference means a corresponding activity at the center. The exercise of any one of the senses means the development of its corresponding brain center. The sum of this development is intelligence. This is what I mean by the psychological import of manual training. This it is which makes the lovers of power value manual training. Each movement of a motor nerve, whether it be in the fashioning of wood or metal or clay, involves a corresponding brain movement. These movements stimulate growth, and growth is what we are after. Intellect is a function of brain surface.

I believe, then, that the very strongest argument for manual training is not the practical value of the skill which it develops, not even the moral significance of the sturdiness which it inculcates, but that it is something which includes these and the other ends of culture, that it is the increased intellectual power which is the necessary physiological result of such training. This is a large claim, and one that has never been urged before, I believe, on precisely these grounds. But it is a claim which can be fully substantiated.

Perceiving, as we must if these considerations are well taken, that manual training means power—because it leads to the development of the brain as an organ, and to increase of function as a result of this growth—it becomes very evident that manual training is by no means the only method of securing this development. It is far from being the end of the purpose which it involves. It is only one out of a group of possible methods which have a common purpose, the development of human faculty. To accomplish

this full purpose we shall need the cultivation of all the senses. What we want, then, is not only manual training; it is something larger than this—tactile training, the training of the eye, the ear, the hand—in a word, the cultivation of all the senses. And this, bear in mind once and always, not alone because the development of these senses means a large addition to the practical art of living, but still more because such a development means increased brain power, and the consequent generation of men and women of greater worth.

We hold manual training, then, not as the last word in education, but rather as a mere preliminary word—a preface which is to lead to that fuller unfolding of human faculty which will eventually be the meaning and purpose of education. We are engaged in a process, the unfolding and perfecting of the human spirit. We can accomplish this process intelligently only by keeping in mind the ideal we wish to realize. It is well to stop from time to time and examine this ideal—to state clearly to ourselves just what it is—and then, in the light of this knowledge, to examine into the efficacy of our chosen means. What do I mean when I say "a man"? Why do I feel a thrill quite different in kind and degree from the feeling aroused by such words as "wealth," "knowledge," "country"? What is this creature who is thus able to arouse in me the deepest reverence of which I am capable? Certainly it is not the average man of the streets, whose main study is bread and butter, with a casual thought to the rearing of progeny. Certainly not the petty trader who barters the glories of a universe for a few trinkets he calls wealth. One can not seriously cherish as an ideal any of the million of dead souls who daily walk our streets and with their small activities pester the beauty out of the days. To discard these types is not pessimism. It is rather a loyal optimism which insists upon the essential dignity and worth of manhood. When I say "a man" I mean a creature very different from these ghosts of the market and factory. I mean a radiant man, one who is the center of an abounding life and in whom is fulfilled the promise of the days. It is quite possible that by holding men so dear we should make certain material enterprises, now much esteemed, entirely out of the question; but, if so, we can better afford to lose the enterprise than the men. It is a devil's price which is paid in men. Education must look beyond boyhood and ask itself for what type of manhood it is planning. What sort of boys will evolve into this type of glorious, radiant manhood? Prigs will not do. No winged creature ever hatched from such a chrysalis. Neither will dullards nor bullies. Nor can we hope for much from the most current type of all, the pale-faced, anæmic boys, with their dull ears, near sight, short wind, bad breath, and a

measure of life too large to permit dying and too small to permit living. What we need for such an evolution is radiant boys, breathing the full breath of life and health, thinking clearly, feeling deeply, rich in the fine riches of the human spirit, the riches that come from the expanding and unfolding of the human faculties.

This is an ideal boy, but it is not an impossible boy. He is a boy of flesh and blood—firm flesh and pure blood—and he shall not be driven out by any cry of Utopian!

It is the sort of boy I have in mind when I pronounce that word which should be a magician's word, the Open Sesame to many a human wonder, the word Education. It is by this standard that I must try all methods of education, manual training among the rest. It is not so much whether they produce this type of boy—we live in a world of the imperfect, one whose beauties are daily sung by the minor poets—but whether they have it in mind to produce them, and do actually tend that way.

Now, I have tried to show that manual training has its face turned toward this perfection, and that it does realize a first step toward its attainment. It is this feeling that urges upon us the necessity of other steps. I see very clearly where we should begin. We should begin with the naked boy. It is not enough to impress his head. It is not enough to impress his hands. Life is a question of the whole body. I am trying at the present moment to introduce physical examination into our own school, and to place our work upon a sound physiological basis. It is an innovation. I do not know whether I shall succeed. Society at present furnishes us with a supply of very imperfect boys, furnishes to us who are a set of very imperfect teachers. Between us, imperfect units on both sides, the process of education is to be realized. It is very evident that the remedy for all this is the generation of a more perfect race. And this dream should be the ever-present dream of education. By entertaining it, it will become less and less Utopian, and more and more American. There is no reason why we should not realize it. There is every reason why we should. We have only to believe more in men and less in things.

But, meanwhile, the imperfection is here, and the problem is how to deal with it.

It has struck me for some time past that the friends of darkness are more successful than we, the friends of light, because they so persistently address themselves to the means of accomplishing their purpose, and only gloat occasionally over the end; while we, with better purpose and nobler end, we, with education and the universe on our side, are so constantly failing because we set our eyes on the end, and its glories blind us to the means.

What reformer so unimaginative that he does not thrill at his own mind-pictures of a perfected humanity! But, alas! how few reformers, however earnest, who are patient enough to build from the mudsills up! For the most part we are a set of idle dreamers. Science has reclaimed from the unknown much more than we teachers have utilized. The laboratory is far ahead of the classroom. To our shame be it said. We know better than we do. The time has come to stop this trifling. I, a man, cry to myself, Halt! And I ask myself what I would do if I did the best I knew. The answer comes clear and unmistakable. I would stop trying to educate boys by the hundred—an impossible task—and devotedly try to educate a little group. I would begin at the beginning. One must know the sort of material one has to work upon. This is the beginning. Education must take in the whole day, and not a mere fragment of it. Knowing the condition of the whole organism, the powers and defects of each organ, our first business is to set about making this organism healthy and adequate for the life of a man. This is a matter of daily *régime* and not of intermittent treatment. It is a matter of food, baths, clothing, rest, and exercise. It can not be divorced from school life any more than it can from home life. This is the first and great requirement. No boy, unless heavily handicapped at birth or by subsequent accident, will fail to respond to such treatment and come out a relatively healthy organism.

Meanwhile, we are not forgetting that power resides in the head. But neither are we forgetting that the head is only made possible by the rest of the body; that the supply of blood depends on that pumping engine down below, the heart; that the condition of the vast system of nerves of which the head is the center depends upon the health of the entire network; in short, that not the least and meanest function of the organism is without influence upon the crown of it all. Education begins by a bodily renovation. And while this renovation is in progress, much else is being done. Each organ of sense is not only to be in health through its own health and the general health of the entire organism, but it is to be gaining power through exercise, for it is the office of the senses to supply the brain with raw material—that is, with sensations. There are many opportunities for such exercise. To begin with, let us consider the eye. Incidentally, all life contributes to its culture, and yet for lack of adequate training it remains a very inaccurate instrument. Its function is to appreciate distance, color, tone, light and shade, proportion. Put in the most general terms, it is to apprehend relations. Many wholesome exercises could be devised to develop these several phases—judgments of distances, discrimination between different colors and different shades of the same color, the evaluation of light and shadow, the

study of the æsthetic principles underlying the sense of proportion. An eye trained in this way would be a source of endless delight, a constant finder of new beauties. And back of the eye is the seeing brain whose growth would be in proportion.

The ear is an equally promising field for training. Think of the world of harmony and music closed forever to those who, like poor Trilby, are tone deaf! Think of the thousand sounds in Nature which are full of meaning to those who have ears and hear; of the countless shades of meaning conveyed by the human voice to those who are sensitive enough to apprehend! At present this realm of sound is to most of us a coarse convenience, a quick way of ordering our dinner, and little more. It might be a garden of delight; and the time to open this garden is in youth, when the tissues are flexible and the life plastic. It is a tragedy that when we might be opening such treasures as these to our boys, we teach them, instead, bookkeeping and interest! And back of the ear is the hearing brain whose growth would be in proportion.

There is no sense organ which might not be stimulated by some well-directed training and made to yield its corresponding brain reaction. Even taste need not be omitted. It would be an exercise of serious value to have a boy learn to detect the percentage of sugar or salt or lemon juice in the glass of water he is drinking, for it would mean the exercise of attention and discrimination. Something might even be done with the nose. Its judgments might be refined and made analytic as well as æsthetic. And, again, back of the tongue and the nose is the tasting and smelling brain, and it is this always that we have in mind.

In manual training we appeal to touch, and incidentally to sight. But we have scarcely broken ground. The hand could be cultivated to a thousand delicacies of touch which are merely foreshadowed in our present clumsy exercises. Both hand and foot are capable of many movements which would add not only to health and convenience, but also furnish nerve and muscle reactions of large value. To sum up the present gains, I would say that manual training gives us increased dexterity and greater keenness of observation. Of still greater value is its higher gift, an increased development of the corresponding nerve centers in the brain, and the consequent increase in general intellectual power.

Here, as the lawyers say, we rest our case.

If manual training has, as I fully believe that it has, this vastly important psychological import, it is the herald of a coming education. If it has not, then its only value is industrial and utilitarian. It is an artisan movement, useful and in its way valuable, but nothing more.

And here let me say very explicitly that the matter is not one to be disposed of, for or against, by mere opinion. In view of its seriousness such disposal would be simply cavalier. It is a matter for scientific inquiry and decision. I am not an advocate of manual training any more than I am an advocate of the vortex theory of atoms. Such a position is not defensible. I stand toward the problem, as I do toward other problems of science, simply as a student weighing the evidence. I would ask for a similar attitude on the part of other teachers, and for nothing more. The final judgment will come, bear in mind, not from schoolmasters and school committees, but from the men who are patiently and experimentally studying the brain as the organ of human intelligence, and mind as a function of brain.

I have here tried to tell the main ground for the faith that is in us—the *raison d'être* of the manual-training cult. One other question remains: What does this training lead to? It is the question of a practical world, of a world which pays the bills, and very properly looks into the quality of its purchase. The question may be answered in two ways: one is the very cold and matter-of-fact way of telling just what the graduates of a manual-training school are doing at the present moment; the other is the more rosy method of setting forth what we think these same graduates, in view of their education, ought to be doing, and what, when manual training shall have done its perfect work, they undoubtedly will be doing. I shall combine these methods by giving the statistics of our own school and then criticising them.

It has become a custom for some of the principal manual-training schools to publish in their catalogues a list of graduates with their occupations. These lists form very instructive reading, for they tell in the most practical way just what the training does lead to. The Northeast School has graduated but two classes, or one hundred and twelve boys in all. An examination of their record shows the following results:

Students:	Electrical engineering	7	
	Civil engineering	6	
	Economics	5	
	Mechanical engineering	4	
	Medicine	4	
	Biology	3	
	Art	2	
	Science	2	
	Arts and sciences	1	
	Dentistry	1	
	Theology	1	
	Mechanical drawing	1	
	Trade school (plumbing)	1	38

Students (brought forward)		38
Technical positions: Electricity	12	
Architectural draughting	6	
Machine work	5	
Pattern-making	3	
Draughting	3	
Iron inspection	2	
Surveying	1	
Engineering	1	
Steel engraving	1	
Wharf-building	1—	35
Reporters		2
Farmer		1
Collector		1
In business for themselves		4
In business with father		5
Mercantile positions		19
Without occupation, or occupation unknown		7
Dead		1
Total		112

The first thing to strike one about this list is the large number of boys who continue their education in higher institutions. One third of this particular company of graduates are now at work in the several departments of the University of Pennsylvania, Cornell, and Drexel Institute, and in other medical, art, theological, and trade schools. The percentage is, I believe, considerably lower than in the four-year classical high schools of New England; but taking all the high schools throughout the country, and the percentage is much above the average. The result is gratifying, for it shows at least that the school has cultivated an appreciation of wisdom if it has not always succeeded in imparting it. Several factors have combined in turning the faces of so many boys toward college. In the first place, a manual-training school is a very practical school, and it does teach and illustrate the fact that if one wants to do good work one must learn how. Many of these boys have a distinct purpose in life, and they are at college in order to prepare themselves for carrying it out. Further, it so happens that a majority of the faculty are college-bred men, and have a sympathetic appreciation of college advantages. We have indeed made a special effort in this direction, and have tried to turn the most promising of our material collegeward, for we do feel that between the man who goes to college and the man who does not there is a difference of mental outlook which makes them the inhabitants of different worlds—a larger and a smaller universe. These influences within the school have been greatly strengthened by the friendly attitude of our university—an attitude constantly manifesting itself in cordial generosity and sympathy.

Almost another third of the boys find their career in technical work, made possible in large measure by the school training. They do not always get on very well with the "practical" men of the shops. A common criticism is that the boys know too much. But this is a criticism which may be interpreted in two ways. At any rate, they have a habit of coming out on top with a speed which indicates that any over-confidence at the start is soon cured. Our own graduates are still quite young, but the records of the Central School and of other training schools throughout the country show a goodly number of manual boys in positions of large responsibility, as teachers, fellows, inspectors, foremen, head draughtsmen, managers, and in other posts not awarded the incompetent.

The remaining third are distributed among a number of callings. It is a matter of regret to me that so many should have been willing to accept mercantile positions. In a number of cases, however, they are held only temporarily until something better can be found. With so many interesting possibilities in the world, it seems, to say the least, a very commonplace disposal of one's self to go into any trading operation. The influence of a manual-training school is decidedly against this sort of thing. I think I may say that it is somewhat aristocratic in its tendencies. It proposes that a man shall gain his living by some useful performance rather than by clever manipulation of stocks and markets. The tendency of manual training is distinctly away from commercial enterprises of a speculative character.

Of last year's class of fifty-nine boys but two are without regular occupation at the present time. This year's class has been less fortunate, for the depression in all manufacturing activities has made it more difficult to secure satisfactory posts.

On the whole, the record is gratifying. It shows that the training has somewhat of that catholic character which has been claimed for it by its advocates. If any judgment may be founded upon the destiny of this particular group of boys, it is clear that the training does lead to a variety of vocations rather than to one particular set. This seems to me a great advantage. The boys in a high school are much too young to elect their future. The training should be of such a general character as to present life in its entirety, and to open the doors of destiny in all desirable directions.

And now one word in conclusion as to what I personally would like to have manual training lead to, for in such a matter I may not so far involve my colleagues in the movement as to use the plural pronoun and say "we." There is discernible some tendency to give the movement a socialistic turn, and to urge manual training on the ground that society needs for its many

activities the skill imparted by such schools. The boys are regarded, if I may so phrase it, as social tools in the making, and a process which turns out useful, workaday tools commends itself to the majority. In a word, the movement is looked at from the point of view of the whole, and notably from that aspect of it which has to do with social convenience. The graduates in manual training are socially useful, because they can do something. Economically they are good products. Now, for my own part, I much deplore this view. I want the social welfare and the social health quite as earnestly as those of my brothers who call themselves socialists, but this social good is a mere phantasmagoria, unless it means the sum of individual good, and it is attained only by attention to the factors in this sum—that is to say, to the individual. As I see life, individual good is the means and the end, and social good but the sign and symbol that this has been accomplished. Looking at the matter in this way, I can not build backward from the whole to the parts. I am forced to build in the other direction. And so I want manual training to lead to no such social illusion. I want it to lead in precisely the opposite direction. I want it to lead to the one great reality in the drama of life—to the unfolding and perfecting of the individual human spirit. I would have it intensely individualistic, leading never to self-sacrifice—which has for its necessary corollary other-sacrifice—but leading always to self-realization, a self-realization so glorious as to quicken neighboring dead souls into renewed life. So I say in effect to each of my boys: "I recommend manual training to *you*—not to society, but to you, the individual soul—that your faculties may unfold and that you may come into the full stature of a man. And I recommend it without reservation, recommend it whatever the trend of your genius, for it means increased power for every performance."

The end, then, in manual training which commends itself to me is not utilitarian or socialistic. It is human, personal, individualistic. I would have it lead first and foremost to complete manhood. There are many social necessities, so called, which lead the other way. There are hundreds and thousands of activities which destroy manhood, but which are urged in the name of society. What crimes are committed in this name! There are the grim fortresses of commercialism, twenty-three stories high, whose dismal, sunless cells are to be filled with young life, and to be its tomb. There are rows and rows of vulgar shops, with their poor wares and bad air, where there can be no thought of human perfection. There are industrial processes whose known cost is human life. There are many-storied factories full of human misery. There are hideous aspects of life called into being, enlarged, and, worst of all, *justified* by this same cry of social necessity.

Now, I do not believe in this. I believe in wholeness, in health, in vitality, in integrity, in goodness, in happiness. And I believe that manual training should lead to these, should lead to them inexorably. The same motive which makes me cherish manual training—the love of power, the love of perfection—makes me deny as its proper outcome any activity which disallows complete manhood. So manual training opens the doors of activity in all directions, only to declare that many of these doors are impossible. It consents only to those activities which, humanly speaking, are worthy; and the test of worthiness is not measured in the economic terms of productiveness; it is measured in the terms of the spirit, in its effect upon the worker. I do not succeed in impressing this view of life upon all of our graduates. I do not succeed in impressing it even upon a majority. But each year it does claim a small company, a company who believe with me that the most sacred thing about life is life, and who decline to violate this sacredness by any petty spoliation of the days. It does seem to us a tragedy that any young man, and particularly any young man in America, where the opportunities for rational living are so abundant, should deliberately elect a suicidal scheme of life, some dull routine which is to curtail experience and limit the universe to a daily round of sordid cares. Perhaps I should not have said deliberately. They do not do it deliberately; they do it because they do not see. They do it because culture and the ideal of life for which it stands have not taken hold of them; because we who represent this view of life have not been sufficiently active, insistent, loving, to win them over to our side. In any case it is a tragedy, and one that I much deplore. When education shall have done its perfect work, our boys and our men will declare with Walt Whitman, in his Song of the Open Road:

> "Henceforth I ask not good fortune, I myself am good fortune."

And it is this to which I would have manual training lead, to the rare good fortune of a rich and full existence.

On account of the absence or loss, in fossilizing, of characteristic features, it has hitherto not been possible to give trilobites a fixed place in the zoölogical system; they by turns have been classed with isopods, phyllopods, and arachnids. Mr. H. M. Bernard, in his work upon The Apodidæ, placed them in that family; but he confesses that, however weighty the argument in favor of that relationship, the inability actually to demonstrate the existence of antennæ was a felt weakness. Recently some sixty specimens of the species *Triarthrus Beckii* were found by Mr. Valiant in the Hudson River shales, near Rome, N. Y., with antennæ, and have been described by Mr. W. D. Matthews in the American Journal of Science. Mr. Bernard regards the presence, structure, and position of the antennæ as justifying and confirming his classification.

ANIMALS THAT LIVE IN CAVES.

By E. A. MARTEL.

THE study of paleontology and prehistoric archæology and the exhumation of the life of the past in caverns have been pursued in France during the last twenty years at the expense of the investigation of the present life, while the fauna and flora of their black recesses and dark waters have nevertheless flourished quite as vigorously as in the subsoils of Austria and America. The naturalists of those countries have, however, carried their investigations in that domain considerably further than those of France. Still, numerous cave-dwelling species new to us have been found in the Pyrenees and the south and east of France.

The zoölogical study of subterranean waters is eminently useful to hygienists, to whom it discloses the presence of noxious organisms capable of developing in the water supplies of cities, and thence finding their way into the human economy.

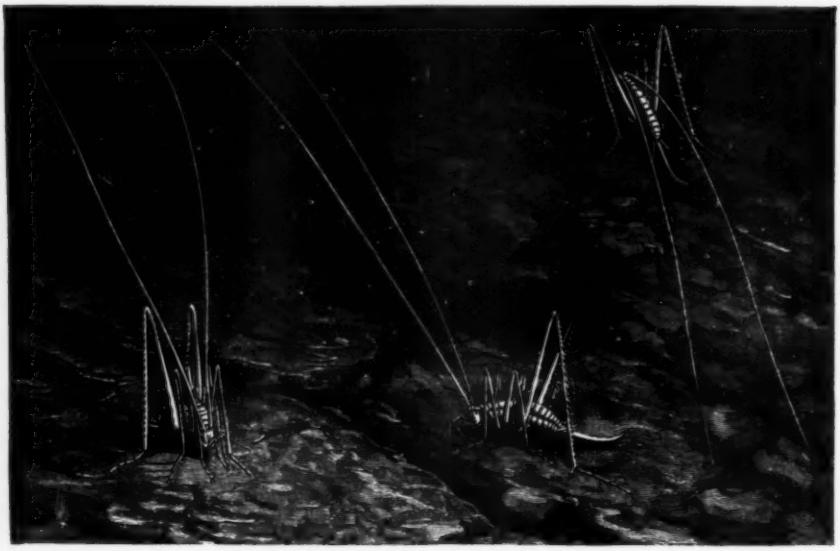
Animals of all classes may be found in caverns. Some, which do not pass all their existence there, but seek shelter in them, have been called by the Austrian Schiner *troglophiles* (or cave lovers), and others, which never leave their dark abodes, are designated by him as *troglobiens* (or cave dwellers). I can not present here even a simple picture of the subterranean fauna actually known; I can hardly even sketch the outlines of the subject and insist on its importance.

The higher vertebrates—mammals, birds, and reptiles—found in caves seem to be chiefly troglophiles. There are, however, real troglobiens among the lower vertebrates—batrachians and fishes. The articulates, in particular, and especially the arthropods—insects, myriapods, arachnids, and crustaceans—have revealed many species previously unknown. The *Dolichopoda palpata*, represented in the figure, was discovered by M. E. Simon, in 1879, in the grottoes of Belvès and Espezel, in the Aube. Worms, mollusks, etc., are not rare.

The list of the fauna of the Mammoth Cave in Kentucky comprises no less than a hundred species, without counting those that come in casually from without. Blind spiders set their nets for eyeless flies. Fish eat crawfish, which feed upon smaller crustaceans pulled with their pincers from beneath the flat rocks, while the crustaceans prey upon defenseless mollusks, and these forage upon microscopic fungi.

The important question of the origin of the subterranean fauna is still invested with a degree of mystery. It was at one time believed and maintained by Agassiz that they were specially created for the medium in which they live. It was afterward recognized

that they are derived from species that have simply undergone external modification. A careful comparative study of the modifications they have undergone, and of their phases, would be necessary to clear up the doubtful points. The doctrine of the evolution of species is concerned in this investigation. The introduction underground of the ancestors of these fauna may have taken place and may be taking place in two ways: through perfect individuals carried by streams into wide-mouth pits, whence they can not escape to the light, or through eggs or larvæ borne into narrow fissures by simple infiltration of water. It is a matter of question whether or not creatures hatched from these germs, which have never lived on the surface, and their descendants,



Blind Insect of Caves (*Dolichopoda palpata*).

would be affected by more rapid changes than those which have come underground by accident, but have not been born there. The principal changes undergone are usually albinism, or more or less complete loss of color, and atrophy of the eyes. The organs of vision become, of course, useless in the underground darkness. It is found, on the other hand, that cave-inhabiting animals have the other senses developed to excess; they guide themselves by means of long cirri or long antennæ, which are very sensitive; they are put on their guard by means of their hearing, which informs them of distant perils; and by their smell, telling them of invisible game, helps them to their food. Albinism is accounted for as the result of failure to absorb the light-rays. It is generally agreed that cave-dwelling animals have lost through adaptation to the medium the visual organ their ancestors enjoyed.

Schioldte, of Copenhagen, and Dr. Gustave Joseph, of Breslau, have made curious studies of the transitions in gradual atrophy of vision from aërial animals to their cave-inhabiting congeners. M. Joseph believes that when the light is diminished in the animal's habitat, dislocation of the eyes takes place, and that the intermediate species are especially domiciled in caves where a twilight prevails, or where a little light enters at noon or in summer. While the *Proteus* and the *Amblyopsis* of the Mammoth Cave have the eyes simply covered by a membrane, some mollusks appear not to have even a place for the most rudimentary ocular globe. We might, however, ask if these different degrees of blindness do not proceed in a measure from differences in the length of time that has elapsed since the species were buried. On the one side, some animals have been found in caves having their eyes preserved in full vigor; on the other side, artesian wells have thrown to the surface, and some subterranean lakes have yielded to the collector, living beings in no wise modified from those living above ground. It has been reasonably concluded from this that these beings have been drawn in by the water that feeds the lakes coming from unknown distant points, and that their abode underground has not been long enough continued to make them blind. It would be interesting to compare atrophy of vision in cave-inhabiting animals or in those of subterranean waters with those remarkable creatures specially adapted to enormous sea depths which have been collected in the expeditions of the Challenger, Talisman, and others of like purpose.

It is perhaps possible to attach too much importance to the blindness of subterranean animals as a peculiarity. A considerable number of species living in surface waters are destitute of vision.*

M. Joseph is of the opinion that "the presence or absence of organs of vision always corresponds with the conditions of existence of the animals." So far as concerns the heredity of atrophies, Hovey says, in his Celebrated American Caverns, that Dr. Hayden witnessed the birth of eight little blind amblyopses.

What we have said is only the present indication of some of the questions raised by underground zoölogy. An ample harvest of facts heretofore not observed may be anticipated from the exploration of the numerous caves of the Causses in France—such as have been made in the caves of Carniola and the United States—or of any caves as yet virgin to scientific examination. The subject is full of interest, and all the more attractive because so much still remains to be found out about it.

The outfit for hunting cave-inhabiting animals includes an

* R. Moniez, Faune des Eaux souterraines.

entomologist's pincers, a fine, strong, close-meshed net, a brush for applying alcohol to the creatures to stupefy them, and vials or bottles of different sizes and shapes for holding the collections, either dry or in spirit. Of special importance are practical experiments on the physical modifications which animals of the outer world may undergo when shut up for a long time in the depths of caverns.—*Translated for The Popular Science Monthly from La Nature.*

THE SHAD'S ANNUAL PILGRIMAGE.

By A. H. GOURAUD.

AS the sun, at the close of his winter's recession, marches into higher latitudes, he awakens in successive zones both animal and vegetable worlds to the full activities of their being, and exerts, even in their remote and hidden seclusion, his influence upon the finny inhabitants of the deep. With the northward advance of the vivifying orb, the shad (*Alosa sapidilla*), the alewife, the menhaden, and other migratory fish wheel into line, and, massed in solid column, approach our coasts, welcome heralds of the spring. Beginning in Florida in January, the various colonies have quitted their ocean abode, and in consecutive order are entering our rivers from the St. John's of Florida to the St. John of New Brunswick. Burdened with the myriad germs of a coming generation, it is the reproductive instinct that impels the shad to quit the security of the deep sea that it may cradle its precious freight in the rocking waters of a clear, running stream.

In common with alewives and menhaden, shad are members of the herring family, which fish they so far resemble that one of the British species is called by the Scotch fisher folk "king of the herrings," an appellation, however, more likely suggested by the commonly entertained belief that the herring shoals are led by one of enormous size, styled the king, and whose capture or destruction is presumed to occasion ill luck to the fishermen. The herring family are in their retirement deep-sea fish, and it is likely that the shad and menhaden winter off our coasts in depths of hundreds of fathoms. At an average of perhaps a hundred miles from the New Jersey and Long Island shore lies the edge of the great continental plateau, beyond which the water deepens rapidly, and there, at no great distance from its border, is probably the abiding place of many of our finny migrants. The fish frequenting each river are probably restricted to neighboring portions of the ocean, it being very unlikely that the different colonies are grouped together, as is generally supposed, in one gathering place. Denizens of the shallows, as well as of the remote profound, they are

therefore subjected to great variations of pressure, not unlikely at times approaching half a ton to the square inch. At its migratory period the shad rises to the surface from the deep, and the sudden change of pressure thereby occasioned would do great violence to its bodily structure but for an apparent special provision of Nature, to be later explained.

In the marine profound there are fishes in abundant variety that exist at depths of several miles, and perhaps also in its nethermost and as yet unknown deeps. Many of these fish seem to be limited to certain oceanic strata to which their organization may be specially adapted and to no other. From time immemorial finny creatures of soft and fluffy substance and distorted shape have been found floating, sometimes dead, sometimes barely living, upon the surface of the sea; but, until the explorations of the Challenger afforded the solution, their nature and origin remained a mystery. The fish then drawn up from the far deep presented upon emergence the same bloated and unsubstantial appearance, which, by the scientists of that famous expedition, was ascribed to the expansion of the contained gases incident to the sudden release of enormous pressure. This expansion had so ruptured or puffed out the tissues of the creature that its entire semblance was without doubt radically altered, the puffy and loosely coherent mass of flesh having originally been a firm and compact substance. Fish of such localized habitat, if venturing too far above their proper stratum, would, despite their utmost effort, be buoyed to the surface by the constantly enlarging volume of the imprisoned gases, dilating measurably with the diminution of the weight or depth of the overlying water, and to such mischances is due the occasional appearance of these forlorn castaways upon the wide bosom of the deep.

Against such injury or inconvenience the shad, in common with its congeners, is seemingly secured by an anatomical peculiarity not as yet fully understood, but believed to be a distinctive adaptation of Nature. In the shad's head there appear a number of tubes presumed to exist for the introduction into the blood and system generally of a sufficiency of water, which fluid may be absorbed or extruded with increase or with diminution of pressure, and the tissues become thus adjusted to the varying strain. This presumptive function does not, of course, admit of experimental observation, and in the absence of such demonstration the mode of operation and, indeed, even the purpose of the singular tubes must to some extent remain a subject of speculation.

Of all our marine food fish shad may be said to be the most popular; as an edible and as a delicacy it appears upon the table of both the poor and the rich, being equally esteemed by the epicurean as well as by the unpampered palate. The Chinese have

a species of shad, *sam-lai* (*Alosa Reevesii*), alleged to be as savory as our own, but larger and less bony. It ascends the Yang-tse-Kiang, a river three thousand miles in length, to spawn in its upper waters, but at the end of its long journey becomes worthless through emaciation. As with ourselves, the first fish of the season command an extravagant price. The Chinese gourmet, however, differing from his Christian brother, maintains that it needs to be neither baked, boiled, nor fried, but only steamed; such treatment, in his opinion, best developing the flavor. In most of the European streams shad are found, but do not equal the American or Chinese variety in flavor or in nutritious value. We have sent a number of shipments of fry to various parts of Europe with the object of stocking its rivers with our superior fish, but the effort has not been remarkably successful.

Very different, however, has been the result upon the Pacific coast, where the greatest and most brilliant feat of marine acclimatization has been successfully accomplished. Little more than a score of years ago the fry were borne across the continent, and assiduous care and attention during their long journey of over three thousand miles assured the survival of a due portion, which were placed in the Sacramento River. From this and a few later shipments has resulted their present abundance along a coast line of twenty-five hundred miles, extending from southern California to Alaska, being in their season so plentiful in some streams that barrels of them are pitchforked out of the water. It was only two or three years after the first planting that a few more or less mature specimens were obtained from the Sacramento. Gradually the number of marketable fish increased until now they almost equal in some of their localities the salmon in abundance, the price having declined from the initial figure of a dollar a pound, obtained while the fish were yet scarce, to an average of ten cents a pound in 1889, and four cents in 1892. From the slender colonies originally transported, forming less than one per cent of the number annually placed in Atlantic waters, and involving the expenditure of a comparative trifle, the inhabitants of a long stretch of coast now derive a valuable and important food supply.

Until the Pacific coast plantings it was assumed that the shad invariably returned to the stream that gave them birth, and this, as a rule, is perhaps correct. The conditions of the California coast evidently operate, however, to the diffusion of the fish, they having in many instances established themselves in rivers far from the Sacramento. This movement may be due to the balmy Japanese current, the Gulf Stream of the Pacific, which laves its northeastern shore and agreeably tempers its climate. Influenced by its genial flow and pursuing its track, the shad have wandered northward, and, if they maintain their advance, as they probably

will, their ultimate establishment in the river system of Asia may be regarded as assured. Owing to various favorable conditions, the shad not only multiplies rapidly in its new abode, but in some localities has modified its habits, being found in varying abundance throughout the year. Moreover, it attains an exceptional size; seven and eight pound fish are common in California, but are almost unknown with us, and there have been exposed for sale in the San Francisco market shad of a weight as high as twelve and thirteen pounds. This superiority in size is not unlikely due mainly to a less actively prosecuted fishery, for shad of equal weight were known to our fathers. The heaviest fish are probably the growth of a number of years, and an exhaustive fishery that each season leaves but few survivors necessarily tends to eliminate the larger individuals.

Upon the Atlantic coast the utmost effort of the Fish Commissioners, supported by ample State and national expenditure, seems powerless to effect a renewal of the abundance of old. No more saddening exhibitions of man's improvidence are afforded than by the noble rivers that have been depleted or exhausted of their finny treasures, and of such perhaps the most striking are those presented by the larger affluents of Chesapeake Bay, the Potomac and the Susquehanna. Sixty years ago, through the greater course of these long streams, both the shad and the alewife, or fresh-water herring, existed in almost incredible numbers. In the Potomac the two species would often ascend the river together, and it was not an uncommon draught to secure several hundred thousand herring and several thousand shad at a single haul. The fishermen, in drawing the seine on shore, would pile the herring knee-deep for twelve or fifteen feet landward, and then walk or wade through the mass, thrusting in their arms and picking out the shad. The herring so stacked would be sometimes sold for a mere trifle, sometimes be given away; often, although an edible fish, and perhaps superior in that respect to the common herring, would be carted off for manure; and sometimes, for lack of even that demand, would be allowed to float away upon the rising tide. In 1832 nine hundred and fifty thousand, accurately counted, were taken out at one draught; the number of shad seined was often four thousand and upward, and the selling price as low as a dollar and a half per hundred fish. Of such destructive fishing a constant decline in the annual catch was the inevitable result, and thus it happened that for some years prior to the war practical exhaustion had been attained. The abatement of the fishery during that period so far restocked the river that it was renewed with profit upon the restoration of peace, but improvidence again resulted in impoverishment. In the early seventies government aid was invoked and extended; many millions of shad fry were

artificially hatched and placed in the river, and thus, by constant reparative effort, a scant measure of plenty is at present with difficulty maintained.

In the golden days of their former abundance no shad were so highly prized as those captured in the upper reaches of the Susquehanna, whose clear, running waters only the better conditioned could attain, and which in their long journey against a fresh and swiftly flowing stream were presumed to acquire a flavor and excellence peculiarly their own. When the first settlers of the Wyoming Valley found their abiding place in the glades of its forested river that beneath the budding leafage of the spring rippled cheerily to the far-distant sea, they were amazed and confounded at the sudden revelation of its wondrous treasure of fish. The dreary winter of seclusion and solitude, of cold and privation, of coarse and scanty food had passed and gone, and the gladdening rays of the returning sun had quickened the face of Nature into joyous life. In their long deprivation the isolated community hungered for the coming fruits of the earth —of fresh food there was little or none—and toil and hardship, unsustained by proper nutrition, told heavily upon the weaker members of the lone and distant settlement. Then it was, in the time of their stress and suffering, that the ocean's bounteous harvest was borne against the fierce current of the swollen river, to diffuse joy and gladness in remote and difficult wilds. It was the assured possession of its fluvial crop that peopled the valley, for not only did this manna of the wilderness tide over the waiting interval between seed time and harvest, but, salted or smoked, afforded a winter supply of nourishing food that during the felling of the forest and the clearing of the land sustained the strength of the industrious pioneer. It, moreover, formed the subject of commerce, or rather, in those rude days, of barter, for the salted product was teamed through the primeval forest to the settlements upon the upper Mohawk and to the infant colonies that struggled for existence where are now the flourishing communities of Syracuse, Oneida, and others of that populous and prosperous section. It has been maintained that the first commercial routes established by mankind were probably those for the acquisition of salt; and the early existence of the ill-defined and perilous way that led to the Onondaga salt springs and to other sources of saline supply instances the assertion. A hundred shad, not unlikely over a quarter of a ton in weight, was the exchangeable value of a bushel of salt, weighing perhaps one fifth as much. Every farmer had an ample store of barreled shad, running from thirty to forty to the pork barrel, a measure that would probably require twice the number of the comparatively immature catch of to-day.

In the van of the ascending shoal that extended from bank to bank of the eddying stream were massed the largest and the strongest fish, the steady, even approach of their densely compacted ranks being betrayed by a nearing ripple, visible at a distance of several hundred yards. From beyond the submerged borders of the continent, whence it had taken its departure, an advance of six or seven hundred miles had been accomplished, with orderly movement and close formation, by this vanguard of the finny host. Day after day, in ocean's gloom and river's light, through billowy forest and far-rolling meadow, unseen and unmolested of man, the column had struggled onward. Battling with a madly contending current, sometimes halting, sometimes retreating,* and again advancing as the swirling waters became colder or warmer, many of the weaker and smaller fell out of the serried ranks, but the larger and stronger pushed unflaggingly forward to the difficult goal. The upper valley, apparently the bourn of their long and toilsome endeavor, was generally attained about the first of April, the males preceding the roe-burdened fish, successive shoals of each prolonging the fishery for some weeks, the best running eight or nine, and in exceptional instances reaching a weight of eleven and even of twelve pounds.

After the desolation of the lovely valley by the memorable Indian massacre of 1778, its widowed and fatherless were the objects of much kindly solicitude, and among the thoughtful administrations of the rugged frontiersmen was what became known as the widow's haul. The first Sunday after the season began the entire catch of the seine, whether much or little, was set apart for their exclusive benefit, and in 1790 one of these hauls, near Wilkesbarre, resulted in an authenticated total catch of ten thousand shad, and even larger draughts were reported from Nanticoke and Bloomsburg. The damming of the river, conjoined with wasteful methods of capture, utterly extinguished these magnificent fisheries, of which former abundance a partial renewal is hoped for from the labors of the Pennsylvania Fish Commission.

The lavish generosity of Nature has everywhere been abused, and the finny treasures of the Delaware have been wasted with the same reckless prodigality and unconcern for the future that have elsewhere marked the fishery. In 1891 the joint action of the commissions of New York and Pennsylvania, in establishing an effective fishway at Lackawaxen dam upon the Delaware, opened an additional hundred miles of that splendid stream to the shad.

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* The chilling of the water, occasioning the retreat of the fish, may be the result of a lowering of the aërial temperature, or of the sudden irruption into the main stream of the ice-bound waters of an upper tributary. In the Hudson shad have been known to retreat fifty and even sixty miles.

Since the erection of the obstruction in 1823 the spawning grounds of the upper river had been inaccessible to the fish; but now, after an absence of nearly seventy years, they are caught at Downsville, N. Y., upon the Popacton Branch, and at Deposit, upon the West Branch, being at their farthest three hundred miles from the sea. Where for two generations they have been unknown exists a promising fishery, which, with provident and careful administration, would doubtless become as bountiful as of yore. It was above this newly opened fishway that the season's largest shad was caught in 1891. As with the Susquehanna, the long journey seems to insure the presence of fish of superior size and flavor, and "Delaware River shad" is now a conspicuous sign in the markets of the West.

In our noble Hudson the construction of dams has not been so disastrous to its fishery, and although the shad formerly ascended to Glens Falls, and even to Saratoga Lake, their spawning grounds are now confined to beds in the river's course between Hudson and the Troy dam. Despite the multiplicity of gill nets, its annual stocking with millions of fry affords a substantial supply, that, however, falls far short of the requirement and is but a poor fraction of the yield of aforetime. Our catch under proper regulations and due access to the upper river could doubtless be greatly enlarged, the last season's product being estimated by the Fish Commission at about eight hundred thousand fish.

In colonial times shad were so extraordinarily cheap and abundant in the Connecticut Valley that a measure of discredit was attached to their appearance on the table. The possession of the salted fish, to the exclusion of the orthodox and more luxurious pork, argued the poverty of the host, and, even when fresh, it was considered vulgar fare, inasmuch as shad sold for years as low as a cent apiece. The denser peopling of the valley and the consequent decline of the catch naturally occasioned a higher appreciation of the once-despised fish, especially among those with whom cheapness is synonymous with worthlessness. The Connecticut is a river of smaller volume than the streams already discussed, and its banks are thickly populated—circumstances tending to aggravate the difficulties of restocking, the principal obstacle probably being, there as elsewhere, the rapacity and improvidence of the fishermen. About 1870, when the effort of the commissioners was begun, they derided their undertaking, but a few years later the whilom scorners begged them to desist, alleging that the abundance was so great that they could get no due remuneration for their catch. The New York wholesale price, they complained, was reduced to three dollars per hundred fish, and they argued that it was useless and a scandalous waste of the people's money to hatch fish beyond the absorptive capacity of

the markets. The general introduction of speedier and of increased transportation facilities, of refrigerator cars, and of cold storage warehouses soon greatly extended, not only the area but also the period, of consumption. Thus it happened that a wider and more enduring market speedily abated the surplus that the fishermen bewailed—a surplus which, under an ever-increasing demand, ere long dwindled to a deficiency. The existence in a densely populated territory of a remunerative fishery, free and open to all comers, conjoined with the adoption of improved devices of wholesale capture, created a lamentable dearth that the utmost effort availed little to relieve.

The river at its mouth discharges its current to the westward, so that along the Connecticut shore of the sound a strip of fresh water extends a dozen miles before mingling with the salt sea. This belt is practically a portion of the river, and the fish, approaching, probably, from the eastern entrance of the sound, enter the strip at its terminus; then, retracing their course, pursue their way through the fresh water to the actual mouth of the river, within which the law prohibits the construction of pound nets. These formidable engines of finny destruction were ranged at short intervals, across the route of the fish, in the fresh-water belt, some of them extending over a mile into the sound. In constant operation, ingulfing fish every hour of the day and night without intermission or cessation, the natural result was the capture, in the sound waters, of the larger portion of the run of shad. When the sorely harried fish finally entered the river, they were beset with scores of gill nets, such as we are familiar with in the Hudson, and which were stretched at short distances as far as Essex, beyond which the poor remnant encountered the sweep nets, which one after another were dragged across the river as fast as possible. In a few years the annual catch declined from nearly half a million to a mere fraction, and at present will average but little more than thirty thousand, the commissioners of late having found it useless to stock with liberality. The State of Massachusetts procured the erection at Holyoke dam of a thoroughly serviceable fishway, thereby opening the upper river to the shad, and, besides, freely colonized with fry the portion that she controlled. The effort was vain, the expenditure useless, and the complaints of her Fish Commission to that of Connecticut that the shad are debarred from her waters have failed to effect material redress. The offending fishermen, however, contend that the lack of shad is due to river pollution, to the diversion of the current by the construction of the Government breakwater at its mouth, and to other causes not subject to their influence or control.

The early settlers in Massachusetts found immense numbers of shad in the various rivers of the colony, and, following the Indian

practice, were accustomed to use their surplus catch as manure, placing a thousand fish to the acre. The Towsers of that day evidently gave trouble, as would appear from the following quaint and amusing town law of Ipswich passed in May, 1644:

"It is ordered that all Doggs for the space of three weeks after the publishing hereof shall have one Legg Tyed up. If such a Dogg should break loose and be founde in any Cornefielde doing any harme, the Owner of the Dogg shall pay the Damage. If a man refuse to tye up his Doggs legg and he be found scraping up Fish in the Cornefielde, the Owner shall pay 12*s.*, besides whatever Damage the Dogg doth."

Of the shad, man, without doubt, is the greatest agent of destruction, although his wasting effort is exerted only within the borders of his own domain; but beyond, in the open sea, the ranks of the migrating horde are thinned by the shark, porpoise, and dogfish, the seal, otter, and salmon, and, most destructive of all, the bluefish. This dread sea butcher works terrible havoc among all neighboring fish not larger than himself, and in the shoals of shad, like those of the menhaden, he revels in slaughter. His opportunity, however, is brief, and perhaps not frequently exercised upon the incoming fish, his earliest appearance in our latitude being usually later than that of the shad. Along New Jersey, however, there have been instances of shoals of shad being driven upon the shore by his murderous onslaughts, the bluefish being a creature that often seems to chop, maim, and destroy for mere amusement.

The shad, after its entrance into our rivers, eats nothing, the one all-dominating impulse being that of the maintenance of its species; for that it braves every danger and endures every hardship. It presses on, sparing no exertion to attain its goal; if it halts or retreats, it is because the temperature of the river current has fallen too low for the development of its ova. It manifests an acute discrimination of gradations of heat, recognizing promptly differences of a degree or even less. In spawning it seeks a temperature of about 60°, and usually deposits its eggs near sunset, when the water is warmest, the place chosen being often the downstream edge of wide flats, over which the gently flowing current becomes heated to the requisite point. That current thenceforward becomes the foster mother of the deposited ova, its suspended oxygen ever vivifying the slowly developing germ, and, thus cared for, the abandoned and apparently neglected waif waxes apace. As soon as capable of independent movement, the tiny fish, scarce half an inch long, with its yolk sac as yet unabsorbed, strikes out for the deeper portions of the river, its instinct possibly teaching it that to tarry is destruction, for there it would become the assured prey of the minnows, killifish, and other small fry that

abide in the shallows. Inasmuch, however, as the young shad possess the continuous dorsal fin along the body incident to the earliest and lowest fishes, the so-called instinct is most likely a reversion to the ancestral habit, such forms being characteristic of deep waters.

Their burden laid down, their object accomplished, the parent fish, worn with privation and spent with effort, turn at last seaward. Emaciated and exhausted, they have become worthless to the fisherman, who frequently observes them dead or apparently dying, drifting down the stream. It is likely, however, that they recuperate rapidly upon reaching the sea, having then access to their customary food, and, if escaping marine carnivora and surviving until the following spring, they renew their arduous voyage, stronger and larger fish, once more to strenuously strive and suffer, but not probably again to return. For the mass of our migratory fish may be likened to some of our familiar wayside plants, that devote their vital energies to the fructification of their seed: with its ripening they wither, with its complete formation they die.

Of the voided eggs, but a very small fraction develop, many are unfertilized, many are devoured by various depredators, many perish by changes in temperature, by floods, or by disturbances of the place of deposit. Of the scanty remnant that become fry, there again results a trifling fraction that mature; many fall victims to innumerable enemies, to lack of sustenance, and to other fatalities. Surviving all these, the young shad in a few months descends the river; then, quitting the fresh water that has nurtured and sustained it, launches boldly out for its distant and unknown home in the obscurity of the great salt sea. Still in its new and strange element does it run the gantlet of danger and death, but instinct guides it to its ancestral abode, whence two or three years later it emerges one of a host of adult fish burdened with a sense of unaccomplished parentage.

Leaving their home in the far deep, the shad, in beginning their annual pilgrimage, rise to the surface and then direct their course landward, the earliest migrants being those in which the propagative function is most advanced. Pursuing their way over the comparative shallows that widely fringe our continent, and joined by other communities bent upon the same devoted errand, they gather in our estuaries and about the mouths of our rivers, and there they linger until the effluent waters are warmer than those of the sea. With the manifestation of this sign the waiting multitude, freighted with a dawning generation that engages their overmastering solicitude, form into rank and column, and with a common impulse set out to conclude their mission of self-immolation and sacrifice for the maintenance of their race.

COMMUNICATED INSANITY.

By CHARLES W. PILGRIM, M.D.

FOR several weeks past it has been scarcely possible to take up a paper without seeing such startling headlines as "Triplets, and all Crazy," "Three Daughters become Maniacs," etc. In fact, so much publicity has been given to the rather unusual number of cases of communicated insanity that have recently occurred in New York, Buffalo, and Philadelphia that the subject has become one of general interest and one upon which accurate information should be given.

The fact that an insane person can, under certain conditions, produce the same form of insanity in another previously sane, or infect him as it were, is indisputable. The French were the first to recognize this fact, and several cases have been reported in L'Encéphale, and other journals, under the term *folie à deux*. It has also been called *folie simultanée* by Régis, and *folie imposée* by Falret.

Although *folie à deux* is not an unusual occurrence, *folie à trois* is quite uncommon, and still rarer, although not unknown, is the evolution of insanity with like symptoms in whole families. Dr. Cramer, in the Allgemeine Zeitschrift für Psychiatrie, reports a most interesting example of the latter kind where a mother and daughter becoming insane, and possessed with delusions of persecution, impressed the same delusions upon the father and five grown-up children. Thus the same form of insanity was imposed upon a family of eight.

Dr. Ireland, in his interesting book The Blot upon the Brain, shows how powerful an influence the insane mind has had upon the sane in the history of religious imposture. He calls attention to the fact that there are people still living who remember Joanna Southcott, who claimed that when sixty years of age she would give birth to the Messiah, and who succeeded in making nearly a hundred thousand people in England believe in her statements.

Brothers, of whose insanity there is no doubt, infected many, and even some among the educated, with his claims to inspiration; and John Thoms, of Canterbury, as late as 1838 collected quite a number of followers whose faith was great enough to make them believe that they would be invulnerable against the attacks of the militia. As a result, Thoms and nine of his credulous followers fell victims to the bullets of the soldiers. But even then all faith was not lost, for many believed that he would rise again within a month. Such psychical epidemics, Kirchhoff believes, are gradually evolved by a sort of "waking suggestion" like the process of suggestion during hypnosis.

An interesting discussion upon the subject of communicated insanity was brought out at the meeting of the Association of Asylum Superintendents in 1887 by the reading of the history of the Pocasset letter-carrier, Freeman, who, with the consent of his wife, who had become possessed of his same fanatical ideas, offered up their son as a sacrifice, in the manner of Abraham. The insanity of the mother was not detected at the time, but in a month she became manifestly insane. As will be seen, this case can not be considered a typical one of communicated insanity, for the remorse and grief which necessarily followed the participation in her husband's fanatical act were sufficient to account for her insanity aside from any influence which he might have had over her. The discussion, however, brought out the interesting fact that several of the superintendents present had had experience with cases which would appear to justify the use of the term "communicated insanity," although others objected to its adoption. One particularly interesting instance was related by Dr. Fletcher, of Indiana, where two brothers and a sister, living on a farm isolated from the rest of the community, became, one after the other, controlled by the same insane delusion. They were Germans, industrious and thrifty, but uneducated and superstitious. The elder brother conceived the idea that the devil had taken possession of their farm and was secreted under a certain bowlder in the barnyard. He imagined that no good crops could be raised until his Satanic majesty had been unearthed. He began searching, and worked for several days rolling up great bowlders until the younger brother, and finally the sister also, became possessed of the same idea, and lent their assistance. They all worked for about six weeks, making an excavation about twenty feet square and fifteen feet deep. They worked so hard and became so emaciated that the neighbors interfered and had them sent to an asylum, where, happily, under the influence of treatment, change of surroundings, and good diet, they ultimately recovered.

Within the past year two sisters have come under my observation whose histories support more fully than any cases with which my reading or observation have made me acquainted the theory that under certain conditions the insane mind may mold the sane mind just as is common with those that are working normally. These two sisters were aged respectively forty-three and thirty; both were unmarried, and, unlike the cases reported by Dr. Fletcher, they were quite well educated and possessed of some literary taste, and were more than ordinarily accomplished in music, both instrumental and vocal. The elder was large, somewhat masculine in appearance, rather aggressive, and possessed of considerable personality. The younger, on the contrary, was

quiet, retiring, and more inclined to follow than to lead. Their father was nervous and eccentric, but had never been declared insane. The mother, while living, with the assistance of the sons, maintained a comfortable home, but after her death the home was broken up and it became necessary for the sisters to earn their own livelihood. The younger was particularly fond of music and was ambitious to obtain a musical education. In order to accomplish her desire they decided to go to Boston, where they hoped by sewing and dressmaking to earn sufficient to support themselves, and also enough to give the younger an opportunity to pursue her musical studies. The result was, of course, disappointing, and they were at last obliged to return to the town which they had left, and there begin what proved to be the bitterest struggle of all. Having previously lived in comparative comfort, their surroundings were altogether different when they found themselves alone, struggling to earn their bread by the use of the needle in their native town. It was difficult to obtain the necessary work, and the elder sister after a time began to think that their lack of success must be due to the work of enemies. From this idea systematic delusions of persecution were gradually evolved which influenced her to such an extent that she could not go into the street without thinking she was being followed, watched, and annoyed. These ideas she communicated to the younger sister, who for some time endeavored to persuade her of their falsity. About this time the elder sister developed the delusion that all her acts were due to the influence of the Holy Spirit, and that she and her sister were to be henceforth inseparable, and that they were to act together under all circumstances and in regard to all things. This idea she also communicated to the younger sister, and at last the oft-repeated delusions had their effect and the passive subject became as clay in the potter's hands. The subjectivity of the younger sister was from that time complete, and soon she developed delusions of exactly the same character and of equal strength; until finally neither could go outside the house with any feeling of safety. They became so suspicious that the most ordinary acts on the part of friends or strangers were misinterpreted, and the finding of an ordinary red necktie which had once belonged to one of the brothers led them to believe that he had become an anarchist. From this suggestion the elder sister conceived the idea that three red stars had been placed on the front door to indicate that it was under the anarchistic ban, and in that way warn and drive away any one who might desire to enter for the purpose of offering them work. This idea was, of course, imparted to the younger sister, and immediately the stars appeared as a reality to her. Thus the active agent not only communicated her delusions to the passive subject but actually trans-

ferred her visual hallucinations. From this state it was easy to get into a condition where anything red exerted a very disturbing influence over them.* As the insanity progressed aural disturbances manifested themselves, and they were made still more unhappy by hearing noises in the rooms above, which convinced them that their enemies were not content to annoy them only when they went into the street, but that they had actually taken possession of the house in order to keep up their torment. One night the elder sister awakened the younger saying that she heard some one walking in the room above them, and that she was sure that it was some one who had come to do them injury. The younger listened and became convinced that they were in great danger, and both claimed that they could feel the presence of the stranger, although they could not see him, and they both smelled the kerosene oil with which he was to burn the house. Believing that they were in great danger, they began throwing furniture out of the house, deeming that the best way of attracting the attention of the police. While in the act of throwing the furniture out they both screamed: "We can not help it. We are not to blame!" They were, of course, taken in charge, and the next day they came under my care. They were separated at once and placed upon different wards in the hospital. In about four months from the time of admission the younger sister had given up all her delusions and had reached her normal condition. The course of the disease in the elder sister was not so satisfactory, however, and, though much improved, she is still influenced by the ideas which controlled her before admission. From frequent conversations with the younger sister after her recovery the fact was made plain that for several weeks she realized that her sister was insane and fought hard to remain uninfluenced herself. At last, however, the sane mind succumbed to the overpowering influence of the insane one, and she became her sister's second self in word, thought, and act. Of course, this would not have occurred had the condition of things been reversed and had the younger sister been the first to become insane. Neither would it have followed had it not been for the neurotic tendencies of the passive subject coupled with the debilitation due to worry, overwork, and

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* This interesting peculiarity reminds us of the dancing mania so graphically described by Hecker in his Epidemics of the Middle Ages. This remarkable epidemic, which began in 1374 in Aix-la-Chapelle and lasted until 1418, when its scene was transferred to Strasburg, was characterized by dancing of the wildest and most abandoned character, which lasted until those who participated in it fell to the ground from sheer exhaustion. Thousands upon thousands were affected by it. Its victims became furious whenever they saw anything red, while on the contrary the same color exerted a remarkable fascination over those who were affected by another form of dancing mania known as Tarantism, which existed later and lasted several centuries.

insufficient food. The close association of the two and the solitary life which they led were also important factors in the case.

I would not for a moment subscribe to the doctrine that insanity is contagious and communicated from one to another, as, for instance, smallpox is, and I altogether repudiate the common idea that it is easy to become a lunatic when compelled to associate with and listen constantly to the ravings of madmen. The immunity of doctors and nurses who live among the insane and associate with them constantly is sufficient proof that under ordinary circumstances, when there is neither hereditary tendency nor neurotic temperament, there is but little danger of being affected by association with the insane. Of course, no medical superintendent would knowingly engage as a nurse one who was ignorant and superstitious, or one who was unduly nervous or inclined to insanity from hereditary influences, and that is probably the chief reason why so few cases of mental trouble occur among those whose lives are passed in the midst of the melancholy wrecks of human minds. This brings to mind the popular fallacy that an insane person is apt to be made worse by being sent to an asylum where he must associate with others who are insane. Experience proves this belief to be entirely unfounded, for as a general thing the insane, being occupied entirely by their delusions, take little notice of their surroundings, and hence the appropriateness of the French term *aliéné*—a stranger to the world in which he lives. Of course, when recovery begins, the situation is different, but even then the associations are not generally injurious, for the convalescing patient often takes an interest in his less fortunate fellow, which does much to promote his recovery, as well as to make him realize that he himself has been insane.

But, notwithstanding my lack of belief in the contagiousness of insanity, I believe, as stated at the beginning of this article, that under certain conditions insanity may be communicated or developed by association, and this paper is written with the hope that some practical hints may be gathered from the observation of cases similar to the ones I have described. It is obvious that when insanity exists in a family it is highly injudicious to subject other members of the family, especially those who are neurotic, to the influence of the insane member. The danger is much greater when the delusions are of a persecutory character, and women are much more liable to be affected than men. Acute mania or dementia are not likely to communicate themselves, but not infrequently a mental breakdown occurs in other members of the family, due to the loss of sleep, confinement, and irregular habits which the home care of such cases involves. When insanity has spread, or communicated itself to another, as it were, the course is plain. Separation must take place at once, and it is not at all

unlikely that under new surroundings and appropriate treatment the passive subject will soon be restored to the normal state. But even admitting that under ordinary circumstances the danger of communicating insanity from the insane to the sane is slight, I shall think that this paper has fulfilled its purpose if it does aught to encourage the early treatment of the insane in hospitals especially designed for the care of such cases. Only those who are familiar with the fact appreciate the danger from delayed treatment, and realize how the chances for recovery diminish as the months pass by without hospital aid. From a careful analysis of the cases with which I have had to do during the last decade, the incontrovertible fact is shown that from six to eight persons recover when placed under treatment within the first three months from the beginning of the attack, where only one recovers when hospital treatment is delayed a year. This fact alone suggests in no uncertain tone the early removal of the patient from the influence of home and friends, even though "communicated insanity" should be considered merely a figment of the alienist's brain.

SKETCH OF PROF. LARDNER VANUXEM.

LARDNER VANUXEM was born in Philadelphia, July 23, 1792, and died at his home near Bristol, Pa., January 25, 1848. His father was James Vanuxem, a shipping merchant of Philadelphia, formerly of Dunkirk, France—a man eminent in business and highly esteemed as a citizen and in social and domestic life. His name was originally written Van Uxem; the form was changed by him partly for convenience in writing, but largely because he had become a great admirer of his adopted country and wished to remove the foreign stamp from his cognomen. James Vanuxem's wife, Rebecca, was a daughter of Colonel Elijah Clark, of New Jersey. Of their fifteen children Lardner was the eighth. Seven of these lived to long past middle life, and two of them to ninety and over. His maternal grandmother's name was Lardner.

Of the early educational course of the subject of this sketch there is no record, and no one living has any knowledge. It is thought that he was for a time a student in the Pennsylvania University, but this can not be verified. He entered his father's counting-house as a young man, but business proved very distasteful to him, his mind having been drawn previously to the cultivation of chemistry and mineralogy. He soon determined to give up all connection with business and devote himself to science. Accordingly, his father gave him the advantage of a three

years' residence in Paris, at the School of Mines, where he became the associate of Prof. Alexandre Brongniart, the Abbé Haüy, and other distinguished men then prominent as professors in the schools of that great scientific metropolis. There he formed an intimate acquaintance with the late Prof. Keating, of Philadelphia, who in the same walks was drinking from the same fountain of knowledge. Being graduated in 1819, after a short tour through some districts of France, investigating the rock formations, collecting specimens, etc., he returned to this country and his native city, "charged with all the improvements of recent chemical discoveries, and the advancement in all its kindred arts." But he preferred the more abstract pursuit of his studies to the application of his knowledge to the practical arts.

Almost immediately after his return home, he was invited by President Cooper, of Columbia College, in South Carolina, to take the chair of Chemistry and Mineralogy in that institution. Becoming a member of the president's family, a warm friendship was formed between him and each member thereof, which ended only with their lives.

In 1826 he retired from the college and devoted his attention exclusively to geology as a profession. During that year he published in the newspapers and in Robert Mill's Statistics of South Carolina reports on the geology of the State, of which he made a survey or assisted in making one, having previously made one of North Carolina. "He also made quite a collection of minerals and rocks of the State, which were deposited in the University of South Carolina."

He then visited Mexico to examine gold-mining property, of which he had been solicited to take charge. His inspection soon convinced him that no profitable results could accrue to the owners, and he advised that it be abandoned.

In 1827–'28 he studied the geological features of the States of New York, Ohio, Kentucky, Tennessee, and Virginia, under the auspices of the State of New York, and made his report to its Legislature.

It was either at this time or immediately after his return from France that he spent much time in geological investigations in the vicinity of Philadelphia in company with Dr. Isaac Lea, who was his chosen and most intimate friend and associate from his early days to the end of his life. Subsequently Dr. Lea honored him by naming after him a class of fresh-water shells which he had been the first to discover and make known. It is from Dr. Isaac Lea's record of him that much of the information in connection with science, contained in the first part of this sketch, is derived. He also made at times extensive and careful investigations in the franklinite districts and marl beds of New Jersey.

In 1830, having returned to Philadelphia, he purchased a farm near Bristol, Pa., and soon after married a daughter of his neighbor, John Newbold, Esq., of Bloomsdale. His farm remained the home of himself and family for the remainder of his life, about seventeen years. "While he often assisted with his own hands," says Dr. Lea, "in the cultivation of the farm, he never at any moment ceased to cultivate his already extensive acquirements in geology, mineralogy, and chemistry, nor to add to a collection of specimens of great extent and rareness."

In 1836, at the solicitation of Governor Marcy, he entered upon what has been pronounced "one of the most magnificent investigations ever made in the geological developments of any country or by any government"—the geological survey of the State of New York. The results are given in Geology of New York, Third District, Albany, 1842. The Third District, of which Prof. Vanuxem had charge, comprised fourteen counties in the central part of the State. The scope of the work performed by Prof. Vanuxem and his colleagues is thus indicated by Prof. James Hall:* "During the few years of field work the New York geologists had harmonized the conflicting views before entertained regarding the relations of the geology of the eastern and western parts of the State; they had traced the boundaries of the successive geological formations, had shown the extent and limits of the iron-bearing strata, and had rectified the erroneous views which had been held till some time after the commencement of the survey regarding the boundaries and distribution of the salt-bearing formation of the State. They had also shown the limits of the granitic formations and their associated mineral products, the thickness and extent of all the limestone, sandstone, and shale formations of the State, and had definitely settled the relations of the rocks of New York to the coal measures of Pennsylvania and the geological formations of the Western States."

The important service rendered to geological science in the matter of nomenclature by the members of this survey is also described by Prof. Hall, as follows: "Since there was no possibility of identifying the individual rocks and groups of strata with those of Europe, as described, the New York geologists were compelled to give names to the different members of the series; and since the sandstones, limestones, slates, and shales are so similar in different and successive groups, it was impossible to give descriptive names which would discriminate the one from the other. Therefore local names were proposed and adopted—as, for example, Potsdam sandstone, Trenton limestone, Niagara limestone, and Niagara shale (the two latter, with subordinate beds,

* In The Public Service of the State of New York.

making the Niagara group), the Medina sandstone, the Onondaga salt group, the Hamilton, Portage, and Chemung groups, thus giving typical localities of the rock instead of descriptive names. This method or system of nomenclature leaves no possibility of mistake or confusion which might arise from a different appreciation of descriptive terms. The typical locality always remains for study, comparison, and reference, and there need be no difference of opinion or discussion as to what was intended by the use of any one of the terms. The progress of geological science in the country is greatly indebted to this system of nomenclature, and to the absolute working out of the succession of the groups, and the members of the same, to which this system of nomenclature has been applied."

At the close of the survey he spent some months in Albany (associated with Prof. James Hall) in arranging the State geological cabinet, the specimens of which he had assisted in collecting, and out of which has grown the New York State Museum. His name was given by his colleagues to several species of the fossils discovered in the course of the survey, and in 1858 Mr. Elkenah Billings named a genus (discovered in Canada) in his honor.

Prof. Vanuxem's private collection of minerals and geological specimens was considered at the time of his death as "the largest, best arranged, and most valuable private collection in this country." The shell and mineral specimens were fine and many of them very beautiful, but it was the geological department, with its numerous specimens of rock and fossil and the perfect arrangement of the whole, giving to the investigator, in the best manner possible, the information sought, and all arranged by his own hands and methods, that constituted its chief value. It was constantly visited by eminent scientists both of this country and from abroad. Prof. Agassiz, Sir Charles Lyell, and Dr. Nicolay were drawn to it on more than one occasion. Those who were in the habit of visiting it most frequently, both from interest in it and its possessor, seemed to be filled with enthusiasm, of whom were Dr. Emmons, Dr. Beck, Prof. Timothy Conrad, Dr. Locke, of Cincinnati, and many others. On one occasion, while engaged on the United States Coast Survey, Dr. Locke brought all his paraphernalia of work and his assistants, pitching his tents in a field on the Vanuxem farm near the house; there he remained for some weeks, continuing his work, at the same time availing himself of the opportunity of study in and examination of the cabinet, making numerous casts of the specimens, especially the rare fossils.

After his death, Prof. Vanuxem's collection was purchased by W. M. Stewart, President of Masonic College at Clarksville, Tenn. It was reported that during the civil war the collection was dissipated and destroyed, but this rumor could not have been wholly

true, for part if not all of the specimens are still there. In May, 1892, one of Prof. Vanuxem's daughters was applied to for information as to the whereabouts of this collection, by a geologist, as it contained, he said, the only known specimen of a certain South Carolina fossil, which he very much desired to examine.

Prof. Vanuxem was a member of and assisted in the organization and establishment of the Philadelphia Academy of Natural Sciences and other scientific associations.

"It was the habit of those connected with the New York survey to meet at Albany at the end of each field season, for the purpose of comparing observations and becoming acquainted with each other. In the autumn of 1838 Prof. Vanuxem suggested that an invitation be extended to the geologists of Pennsylvania and Virginia for the purpose of devising and adopting a geological nomenclature that might be acceptable to all those who were then engaged in the State surveys, and thus become the nomenclature of American geology. This meeting was finally held in 1840, and then the Association of American Geologists was organized, which is now succeeded by the American Association for the Advancement of Science, one of the largest scientific bodies in the world."

Some few years after the close of the New York survey, Prof. Vanuxem was solicited by Prof. Henry, of the Smithsonian Institution, at Washington, to become his associate in charge of that institution. Although it would have been a work in many ways congenial, the offer was declined, for various reasons that he deemed good ones.

In addition to the report that has been mentioned, and numerous papers on scientific subjects published in the American Journal of Science, he published An Essay on the Ultimate Principles of Chemistry, Natural Philosophy, and Physiology (Philadelphia, 1827); but it is his Report of the New York Survey which it is said "will remain his monument, and on which the reputation of his scientific attainments is based."

It would seem as though a man as devoted to science as the subject of this sketch would have his time and thoughts completely absorbed thereby, but not so in this case. The investigating turn of his mind prompted the examination of abstruse subjects, and to him the Scriptures presented an unlimited field. His careful scrutiny of the sacred writings and close study of all the extant commentators upon them resulted in an immense pile of manuscript books which he left as a monument of his interest in the subject, untiring industry, perseverance, and love of research, if nothing more. Although trained in the Presbyterian faith by his mother, Prof. Vanuxem had adopted, and expressed in these writings, views which were too broad and too far in advance of the time to be considered "orthodox."

Every attempt to extend the bounds of human knowledge or to give the benefit of enlightened direction to the activities of mankind aroused his interest. His attention was thus drawn to the so-called new religions, Mormonism and Millerism, as they arose; to the religious teachings of Channing and Emerson; and to the study of Egyptian antiquities. He studied phrenology, and became a believer in its theories. At a time when the subject had hardly been thought of he was a strong advocate of the emancipation of woman from the narrow sphere of activity to which she had been confined. General literature did not have the absorbing interest for him that scientific subjects did. As for music, it appeared to have no charms in his eyes; he declared that far too much time was wasted over it. This fact seems rather unaccountable, as all his brothers and sisters were devoted to the art, and some of them proficient in it.

For Benjamin Franklin's character and achievements he had the highest admiration; honoring himself and his place by naming it after him "Franklin Farm," and the entrance hall of the house was adorned for many years by a bust of the great man; attention often being called to it as "the presiding genius of the place."

To complete the picture, even of a man of science, the social and domestic side of his character and life as well as daily occupations must not be omitted. He was kind and gentle in manner and speech, his somewhat quick temper being under complete control. Though his children stood rather in awe of him, as did many others (of his subordinates), he ruled them by affection and "treated them as intelligent beings," as he said, the result being the most implicit obedience.

His active mind was engaged frequently upon subjects requiring deep thought while his hands were executing works of minor importance. On being asked why he did not plow his own fields, he would reply that he never liked to engage in any manual labor that absorbed the whole attention, as he desired to keep his mind free for other matters. His knowledge of chemistry was brought into use in the cultivation of his farm—much to the amusement of his less enlightened neighbors, who did not believe in "book farming." He had learned the use of carpenter's tools when a boy, for his father, in order to keep his sons off the street, had wisely provided them interesting occupation at home by fitting up a shop for their use. Prof. Vanuxem turned his skill to account in making the cases and chests of drawers in his cabinet—a room measuring about fifteen by twenty-five or thirty feet—and otherwise as occasion required.

"Always cheerful, intelligent, bright, and full of anecdote," it has been said of him, "he was gladly welcomed into every social

circle." Both frugality and generosity were prominent traits of his character. More than once did he take into his household, for indefinite periods, young relatives who needed assistance. His table was abundantly supplied and his house was well furnished with comforts, but extravagance in anything he strongly deprecated, especially in dress. "Love of dress," he used to say, "had caused more sin than anything else in the world."

Careful and neat to an extreme himself in his habits and arrangements, he exacted the same from those around him as far as possible. Of the courtesies and conventionalities he was most scrupulously observant, and was greatly annoyed by any breach thereof, as when any of his Quaker neighbors, coming in, would sit with hat on in the house. Obedience to the "golden rule" appeared to be the guide of his life, as he was wont frequently to hold it up to his children, that they should make it theirs.

He had the reputation of being visionary and full of untenable theories. This may have been true to some extent, and it would certainly have appeared to be the case even if not so, for it was often said by his scientific contemporaries that "he lived too soon, being many years in advance of his times; people were not prepared for his discoveries and theories, and therefore not able to appreciate them, even the scientific world." He was considered also "a very peculiar man," which was not surprising, in view of his independence of general opinion, in following out what he considered the right or best course in any matter. As an illustration might be given a description of his equipment for the New York survey. It consisted of a four-wheeled wagon with buggy top, covered with white canvas for coolness, with a box at the back large enough to hold his requirements for the season, and working implements. This was drawn by a large, rusty-brown mule, very far from handsome, but strong, trusty, faithful, with powers of endurance much beyond those of a horse. He was often not a little amused at the comments and ridicule that this equipage provoked, but it was the thing that best answered his purpose, so he went on his way and let them laugh.

Finding it necessary to turn his acquirements to some pecuniary advantage, was one of the inducements of Prof. Vanuxem to engage in the New York survey. The working for "pay" was one of the things for which he had a great aversion, "a feeling," as he writes, "he never could conquer." He wanted to be able to work for the public without charge and not feel that his time belonged to some one who had a right to its control; he was too conscientious to feel any freedom when under bonds of this sort.

Physically Prof. Vanuxem was below the average in height, rather slightly built, active, energetic, with great powers of endurance, and persevering in whatever he undertook. He was

always in good health, being "temperate in all things," and, though often furnishing wine for his guests, declining the use of it himself, as he said he wished to keep his head always perfectly clear. To tobacco in all its forms he had a great aversion. One of his theories was that human life was much too short, either because of too much luxury and self-indulgence on the one hand, or lack of proper sustenance on the other. By striking the happy medium, he believed life might be indefinitely prolonged. His last illness was of about three weeks' duration, and caused by a carbuncle on the upper lip. After a time the brain became affected and unconsciousness ensued, which continued uninterruptedly until he passed away, having seen but fifty-five and a half years. This early ending of his life seems like the irony of Fate! The many letters received by the family after his death, from those with whom he had been associated in his scientific career, filled with such heartfelt expressions of sorrow and regret for the personal loss and the loss to science, attest to the estimation in which he was held by them all.

The original of the likeness accompanying this sketch was a daguerreotype—the only portrait of any kind ever made of Prof. Vanuxem. This was taken in a group in 1846, in the early days of the art, when the arrangement of dress and pose was not understood so well as afterward. Hence the eyes, said to have been his best feature, are unfortunately cast down, as he was told to look at the child seated on his knee. The portrait is like him, but has not the pleasing aspect his countenance always wore.

It appears from a discussion by Prof. Holden, of the Lick Observatory, of the smallest object on the moon that can be registered on the photographic plate by the three-foot refractor, that a crater on that star less than one tenth of a mile in diameter will form an image that is about the same size as the grains of silver in the photographic film, and can not in general be distinguished. Craters not more than three tenths and fifteen hundredths of an English mile in diameter, however, have been detected already. Prof. Holden concludes that for further advances in lunar photography it will be necessary to employ plates of greater sensitiveness so as to shorten exposure, and also plates in which the grain is finer.

The "southerly bursters" of Australia are storms that occur very suddenly, and mostly between November and February. A fresh northeasterly wind may change in ten minutes to a gale from the south, doing much damage to vessels that may be unprepared. The storms are always accompanied or preceded with great electrical excitement, and cause a considerable drop in the temperature. The wind velocity used to reach from sixty to eighty miles an hour, and on one occasion attained the rate of more than a hundred and fifty miles an hour, in a gust. Latterly, however, the wind seldom exceeds fifty miles, and generally ranges between thirty and forty miles an hour. The average annual number of storms is thirty-two.

EDITOR'S TABLE.

WIDENING THOUGHT.

WE do not know a more encouraging sign of the times than the vastly improved *entente* now existing between those two forces, which only a generation ago seemed to many to be irreconcilable enemies—science and religion. There were not wanting, at the time we speak of, wise men who asserted that the conflict between these two must be the result of misunderstanding; but, in general, the partisans of religion were convinced that any science, so called, which threatened their special beliefs must be absolutely false, while some at least of the partisans of science were disposed to hold that, because some specific theological tenets had been proved unsound, the whole basis of religion had been shattered and destroyed. Of course, remnants of these errors may be found lingering here and there even now; but in centers of thought and culture very different ideas have begun to prevail. We noticed some time ago, in another department of the Monthly, an excellent work by the esteemed President of Rochester University—Genetic Philosophy—which was thoroughly in line with all that is best in the modern scientific spirit; yet Rochester University, if we mistake not, is an institution under the control of the Baptist denomination. More lately still we called attention to the liberal and hopeful utterances of the Presbyterian clergymen who were celebrating the jubilee of Knox College at Toronto, Canada. We now find an admirable article in the December number of The New World, bearing the title Science a Natural Ally of Religion, which again we may credit to the Baptist denomination, as it proceeds from the pen of Prof. E. Benjamin Andrews, of Brown University, Rhode Island.

According to Prof. Andrews, who states his case very well, it has come to this, that science, which bigots and fanatics on one side or the other once accounted the natural foe of religion, can and must now be claimed as its natural ally. Science, Prof. Andrews tells us, has done the work of religion in unifying human knowledge, and thus leading our thought by necessary stages to the recognition of one First Cause of all things. We have been led to see that there are not *forces* in the world—that there is but one *force;* and we have been set free from the crude materialism which unintelligently deified matter as the one self-existent reality. The doctrine of evolution, far from being an impediment to religious faith, "opens the way for an apprehension of the Divine Being and his modes of procedure far more rational, helpful, and uplifting than the time-honored creationist view." Or, as he otherwise expresses it, we see in evolution "simply the slow march of creative energy." The old idea represented the Deity as forming a plan, just as an architect might design a house, and then, when all the details had been worked out, proceeding to realize it. According to the evolutionist view, "we can not think of the Divine Being as ever having been without a world. He creates from all eternity, and the product each instant is a brand-new work entire, which, though God's creature, is yet not external to him, but rather the sign of his own living, throbbing presence."

Science, Prof. Andrews further claims, has rendered philosophic skepticism henceforth impossible—such skepticism, for example, as that of Pyrrho of Elis and the later Academics. How far this is true, as a matter of exact logic, we are not prepared at this mo-

ment to say; but what science undoubtedly has done is to render the tone of mind of the ancient skeptics almost impossible in the present day. With so vast an amount of truth demonstrated for all practical purposes, so that it daily serves as the basis of action in the present and prediction for the future, no one not a born sophist would care to take up the Pyrrhonic parable that knowledge is an impossibility. By increasing to so vast an extent the compass of human knowledge and revealing the mutual interdependence of phenomena, science has made for every one of us an intellectual system vastly surpassing in solidity anything that was possible for Plato and his contemporaries.

We are not concerned, however, to indorse all the expressions used by Prof. Andrews; what we wish to call attention to is his cordial acceptance of the methods and conclusions of science, and his emphatic assertion that not only does he find nothing therein to impair religious faith, but that, on the contrary, he regards science as rendering an indispensable assistance to such faith. We have ourselves, on more than one occasion, put on record our belief that the religious instinct in man is an essential part of his nature; so that, closely as it may seem to be connected at any time with particular dogmas, it will not perish if those dogmas should be overthrown, but will appropriate to itself other intellectual forms that will serve its purpose as well as or better than the old. The article we have been considering is an example and proof of this. The doctrine of evolution has become to Prof. Andrews and to those who think with him—and they are many—almost a religious symbol. It has certainly become to them a means of expressing religious as well as scientific thought. Religion, after all, is simply the overflow of the human heart toward a transcendent power which reveals itself in us, if not at all times, at least in our best and highest moments. We find it nobly exemplified in a passage of the heathen sage Epictetus: "If we had understanding," he says, "ought we to do anything else both jointly and severally than to sing hymns and bless the Deity, and to tell of his benefits? Ought we not, when we are digging and plowing and eating, to sing this hymn to God? 'Great is God, who has given us such implements with which we shall cultivate the earth; great is God, who has given us hands, the power of swallowing, a stomach, imperceptible growth, and the power of breathing while we sleep.' This is what we ought to sing on every occasion, and to sing the greatest and most divine hymn for giving us the faculty of comprehending these things." Coming down to our own century, the poet Coleridge expresses in a few pregnant words, but from another point of view, the essential nature of religion when he says in one of his translations from Schiller:

> "For the stricken heart of love
> This visible universe and this common world
> Is all too narrow."

In Epictetus we see the overflow of the glad heart, while Coleridge tells us of the overflow of the sorrowful heart. The aspiration and exultation of the one and the yearnings and pleadings of the other meet in the common thought of God. This is religion divorced from dogma, religion which no scientific investigation, no development of knowledge, can ever shake or annul. Science henceforth is free to work in its own sphere, by its own methods, and religion is free to comfort, to elevate, and purify human nature by bringing it into contact and relation with the thought of that which is highest and best and most enduring in the universe, with the thought of a Justice that is above human justice, a Love that is above human love, and a Sympathy that is denied to none. When we think of science and religion in this

way we see how natural it is that they should act in unison, the first revealing more and more of the beauty and order of the world, the second giving its sanction and aid to what we may call the transcendent effort and impulse of the human mind. In view of this common ministry of blessing how petty seem all the disputes of the past! Let us hope that we have heard nearly the last of them, and that, henceforth, as the poet says:

> "Mind and heart, according well,
> May make one music as before,
> But vaster."

A DISEASE OF MODERN LIFE.

In a recent number of the Contemporary Review Prof. T. Clifford Allbutt discusses in a very interesting and instructive manner the question whether, as commonly alleged, nervous diseases are much more prevalent in the present day than they were a generation or two ago. His conclusion is that such is not the case. He disputes, in the first place, the statistics which seem to show that insanity is greatly on the increase; and, in the second place, maintains that in a great many cases in which the nervous system is affected the trouble is not primarily nervous at all: the nerves have been implicated through disorder in other regions of the body. He believes that some of the conditions of city life are unfavorable to the health and vigor of the so-called laboring classes; but he thinks that, on the whole, there is a marked increase of vitality and power in the more favored classes. "I do not hesitate to say"—we take pleasure in quoting this encouraging statement—"that when I look back upon the young men and women of forty and thirty years ago, I am amazed rather at the physical splendor and dashing energy of our young friends of to-day. The world seems to have filled with Apollos and Dianas; cheap food and clothing, improved sanitation, athletics that bring temperance with them, frequent changes of air and scene, and a more scientific regulation of all habits, seem since my adolescence to have transformed middle-class youth, and the change is rapidly spreading downward." Women, the professor says further, seem especially to be changed for the better. "Freedom to live their own lives and the enfranchisement of their faculties in a liberal education, which, physically put, means the development of their brains and nerves, seem not only to have given them new charms and fresher and wider interests in life, but also to have promoted in them a more rapid and continuous flow of nervous spirits, and to have warmed and animated them with a new vitality both of body and mind." The professor is eloquent, but no one will affirm that on such a theme eloquence is misplaced. The question may now be asked, If there is so much cause for congratulation in the physical and mental condition of the present generation, where do we find the darker lines of the picture? Our headline speaks of A Disease of Modern Life. What is it?

The disease of modern life which Prof. Allbutt recognizes is lack of self-control. It is not that nerves are too excitable—their business is to be excitable, he remarks—but that a certain power of what may be called inhibition is largely lacking. What is wanted is not that there should be less sensibility, but that sensibility should not be confined so much as it is to the external parts of our nature. Let sensibility be more profound, and the whole man will be a gainer. We can not do better, however, than quote the professor's own words: "As we become more and more able to subordinate the impressions of the moment, and compare them with our stores of previous impressions, we learn that momentary realities, keen as they are, must take their places in the larger sequences of that beautiful instrument which harmonizes our joys and resolves our discords; we learn

anew that happiness lies in the pleasures which abide and in the selection of permanent beauty and truth from the bitter-sweet of passing delights. . . . As the common mind of successive generations, by sifting and sublimating its experiences and conceptions, discovers its classic thinkers and its classic artists, so, in the life of the individual man, should experience be refined and conceptions enlarged until our desires and pleasures are purged of their grosser and more transient accidents." This is well put, and so is the following: "The discipline which leads us to avoid the eddies of the current and to move in the larger periods of human life and thought, which reveals to us the fugitive and deceitful nature of selfish gratifications, and the abiding joy of devotion to higher ideas, is medicine for neuroses. We preach no self-denial for its own sake, but renunciation of the harlotries and enchantments which minister to transient joys in oblivion of the future."

This is wholesome reading for those who, because they weakly yield to superficial impressions and momentary gusts of feeling, think themselves the victims of an extraordinary refinement of nervous organization. What such persons have, judging merely by the outcome in action, is an inferior nervous organization, one which is all activity on the surface and all inertness below the surface. Professor Allbutt seems to think, however, that in many if not in most cases the deeper regions of the nature might be stirred if a proper discipline were employed. He does not compare the too facile nervous responses which so many exhibit to the imperfect physical habits of breathing, eating, walking, etc.—which are also widely prevalent; but he evidently regards the former as a phenomenon quite akin to these, and therefore more or less remediable by proper measures. The only remedy that unaided Nature knows is suffering, which long centuries ago the sages of the human race saw and proclaimed to be the great teacher of virtue and wisdom; and possibly the function of suffering in this respect will never become wholly obsolete. Prof. Allbutt, however, thinks that proper educational influences might do a great deal to redeem human life from the sway of the momentary. One's heart does fail just a little at the thought of combating by educational effort anything like a general tendency—of trying to induce forces to take a line of greater rather than one of less resistance; and yet the duty of making the attempt seems to be plain. The evil with which we have to contend is in full sight. We see it in all the devices now existing in such profusion for reducing intellectual labor and the strain of attention to a minimum. We see it in flashy newspapers, in idle illustrations, in chopped-up articles, in manufactured witticisms of irredeemable and inexpressible inanity, in shows fit only for children offered for the entertainment of men and women, in vapid social amusements, in a general impatience of whatever is serious and solid, in the levity with which attacks on fundamental institutions of society and established rules of morality are regarded, and in numberless other signs of a prevalent disposition to treat sensuous pleasure, however fleeting and however unworthy—so long as it fills a vacant moment—as the one intelligible end of existence. The teaching, if we understand Prof. Allbutt aright, which he thinks might be greatly influential in mending this state of things, is the teaching of social duty. "I speak as a physiologist," he says, "when I say that, in the growth of higher and more penetrating conceptions of national life, and in the increasing sense of security, efficiency, and vigor which result from organization, we shall find the cure for the irregular nervous outbursts, moods of despondency, and waste of effort which we certainly have continual cause to lament." At present, he adds,

while we "minister to impressions that are skin-deep and transitory, we leave vast inner tracts of the nervous system uncultivated." One great cause of the evil may lie in the fact that to-day a certain superficial education is all but universal—an education which favors a superficial life—and that the education which reaches those deeper tracts that the professor speaks of is, through the spread of the other, becoming increasingly scarce. The true note of a high education is generous enthusiasm; the equally true and authentic note of an inferior education, even though conducted within the walls of a famous university, is the spirit of selfish competition. The world never had so many teachers by profession as it has to-day; but possibly it never lacked teachers in the highest sense more than it does to-day—teachers who are fountains of inspiration to all who come within their influence, because, in their teaching, deep calls to deep, and the nature of the pupil is inwardly molded into the image of a true humanity; not merely fashioned from without into fitness for a struggle in which the hindmost is piously consigned to — the best help he can get.

LITERARY NOTICES.

FROM THE GREEKS TO DARWIN. An Outline of the Development of the Evolution Idea. Columbia University Biological Series. I. By HENRY FAIRFIELD OSBORN, Sc. D. New York: Macmillan & Co. Price, $2.

PROF. OSBORN has undertaken in this work the interesting and useful task of tracing from the earliest times down to the present day the course of speculation and discovery which resulted in the establishment of the Darwinian theory of the origin of species by natural selection. This being his specific task, we could wish that the author had drawn more clearly the distinction between the discovery and enunciation of the law of natural selection and the discovery and enunciation of the law of evolution in its most comprehensive sense. We do not, indeed, find this distinction drawn anywhere throughout the work; on the contrary, we find in many places a somewhat loose application of the wider term evolution to the narrower theory of natural selection, with a certain amount of resulting confusion. "The evolution law," he tells us, "was reached not by any decided leap, but by the progressive development of every subordinate idea connected with it, until it was recognized as a whole by Lamarck and later by Darwin." Compare this with Prof. Huxley's statement of the case: "In the Origin of Species, and in his other numerous and important contributions to the solution of the problem of biological evolutions Mr. Darwin confines himself to the discussion of the causes which have brought about the present condition of living matter, assuming such matter to have once come into existence. On the other hand, Mr. Spencer and Prof. Haeckel have dealt with *the whole problem of evolution* (Italics ours). The profound and vigorous writings of Mr. Spencer embody the spirit of Descartes in knowledge of our own day and may be regarded as the Principes de Philosophie of the nineteenth century." (See Collected Essays, Vol. II; also Encyclopædia Britannica.) Prof. Osborn tells us, referring to Darwin, that "in the middle of this century came the man who ranks as the great central thinker." This was certainly not Darwin's estimate of himself. His strong point, as he often remarked, was observation. He looked at his facts hard and long until they seemed to teach him something, but he expressly disclaimed any special talent for generalization. This he recognized as belonging to Mr. Spencer in an altogether eminent degree. "I suspect," he wrote to Prof. Ray Lankester, "that hereafter he will be looked at as by far the greatest living philosopher in England; perhaps equal to any that have lived."

Nothing could be further from the wish of any one connected with this journal than to belittle in any way the work of Charles Darwin. That he was the author of a great and fertile idea which has worked almost a complete revolution in biological method all the world is aware. It is only a month or so since we quoted in these very columns the testimony borne by Prof. Huxley to the value and importance of the Darwinian theory as

formulated and understood by Darwin himself. We desire, however, that justice should be done to others as well as to Darwin; and if there is not in the work before us a deliberate attempt to ignore the claims of Herbert Spencer as an exponent of the theory of evolution we are greatly deceived. Turning to the index, we find the following entry: "Spencer, early publications, 215"—that and nothing more. Turning to page 215, we find it mentioned that Spencer was "one of the few out-and-out evolutionists before the publication of the Origin of Species." A reference is made to two of his early essays as bearing this out, and the following quotation is given from one of them: "Any existing species, animal or vegetable, when placed under conditions different from its previous ones, immediately begins to undergo certain changes of structure fitting it for new conditions." In all (including the quotation), sixteen lines of large type are allotted to Mr. Spencer; and this is his share in the volume. In the bibliography at the end of the book there is *no mention of his name;* not even the two early essays referred to in the index are allowed a place. Yet one of the headings in the bibliography is, "The Natural Philosophers and Speculative Evolutionists." Mr. Morley is there, on the strength of his work on Diderot and the Encyclopædists; and G. H. Lewes, on the strength of an article published in Fraser's Magazine in 1857; Mr. Fiske is there, very properly, on the strength of his Cosmic Philosophy; but Mr. Spencer's works, on which Cosmic Philosophy is professedly based, are absolutely ignored. How is this to be explained? It would be ridiculous on our part to enter upon a serious argument to prove that, as a "speculative evolutionist," Mr. Spencer occupies simply the foremost position in the world to-day. Darwin fully recognized the fact; Huxley recognizes it; Mr. Sully, who has gone over very much the same ground as Prof. Osborn, says that "the philosopher who has done more than any one else to elaborate a consistent philosophy of evolution on a scientific basis is Mr. Herbert Spencer"; Mr. Leslie Stephen, in the introduction to his Science of Ethics, speaks of Mr. Spencer as "the leading exponent of the philosophy of evolution," and of his having "worked out an encyclopedic system of which his ethical doctrine is the crown and completion"; Geddes and Thomson, in their very able work on The Evolution of Sex (Contemporary Science Series), refer repeatedly to Spencer, and say pointedly that to him is due "the first adequate discussion of growth." But why multiply opinions? Mr. Spencer is not beyond disparagement, or attempted disparagement, by smaller minds; but in the judgment of the foremost men of the present day his position as an original, powerful, and most fertile thinker, in regard to the problems of evolution in general and of biology in particular, is decisively established. The omission, however, of Mr. Spencer's name is not the only peculiarity of Prof. Osborn's bibliography. We look in vain for the names of Romanes, Grant Allen, Patrick Geddes, J. Arthur Thomson, and Andrew Wilson, not to mention any others. It can not be urged in explanation that the bibliography only comes down to the date of Darwin's Origin of Species, because it contains dates as recent as 1892. We can only conclude, therefore, that a partisan effort is being made to keep as much as possible from the knowledge of Columbia students in biology not only Mr. Spencer's work in biology and the general theory of evolution, but that of other writers who recognize the commanding position which he occupies.

The historical sketch, which the work before us purports to give, is in general well done, and the student who masters it will have a tolerably correct and complete idea of the work of Darwin's predecessors. To many doubtless the information given will come as a surprise, so widespread is the idea that evolution sprang in full armor from the brain of Darwin. Darwin himself was surprised when he took to reading Buffon. "I have read Buffon," he says in a letter to Huxley; "whole pages are laughably like mine. It is surprising to see how candid it makes one to see one's views in another man's words." Darwin was a man who was candid at all times, and not only candid but generous. Were he still living he would be foremost in regretting that a book written, as we may say, in his honor should have done so much less than justice to one whom he honored and esteemed so highly.

FUNDAMENTAL PROBLEMS. By Dr. PAUL CARUS. Second edition, enlarged and revised. Chicago: The Open Court Publishing Company. Pp. 373. Price, $1.50, cloth; 50 cents, paper.

THIS attempt to present the method of philosophy as a systematic arrangement of knowledge is a collection of essays that appeared originally as editorial articles in The Open Court, revised in the light of the criticisms they then drew out. The author has endeavored to avoid originality; that is, to introduce as little as possible of his personality and his private sympathies with, or antipathies against, other solutions. Philosophy is presented as the most practical and most important science, because its problems lie at the bottom of all the single sciences; and as furthermore the foundation of the rules of our conduct. In this book is proposed a philosophy of most radical free thought, unincumbered by the excrescences of negativism and hedonism, "that is, no negativism, no agnosticism, and no metaphysical mysticism, but a systematic arrangement of positive facts"; and religion and modern science, ethics and politics, industry, mercantile enterprise, and socialism, in their present existence, are regarded as alike based upon the teaching of the positive school. In this second edition of the work are inserted an introductory chapter on Ontology and Positivism, and an appendix containing the author's replies to his critics.

ELECTRICITY AT THE COLUMBIAN EXPOSITION. By J. P. BARRET, Chief of Department. Chicago: R. R. Donnelley & Sons' Company. 1894. Pp. 501.

THE author modestly disavows claims to originality in the composition of this work, and characterizes it as nearly resembling a compilation. He deserves credit for the excellent manner in which he has done his work. The general introduction gives a brief account of the electrical expositions previous to 1893. The introductions to the several chapters present a scientific though cursory survey of the various applications of electricity and their bearing upon the exposition. The great extent of the department made it impossible to describe all the exhibits; only the unimportant ones, however, were omitted, and the book as a whole presents a good general view of the electrical exposition, together with a large amount of detailed information concerning the various branches of electric art as represented at the fair. Arts and industries in general are dwelt upon where they have any bearing on electricity. Everything is up to date, even Moisson's process for the preparation of artificial diamonds being brought in in connection with electric furnaces. The various branches of electric industry are so closely allied to each other that it is often pretty nigh impossible to draw a line of separation between them; and, though the matter is is well arranged and classified, the specialist will have to consult most, if not all, the chapters in order to obtain full information in any connection. The typographical appearance of the book and the numerous illustrations deserve high commendation.

THE PSYCHIC FACTOR. By CHARLES VAN NORDEN, D. D., LL. D. New York: D. Appleton & Co. Pp. 223. Price, $1.25.

THIS volume, although intended as a manual for students, gives in a very readable form what is known of the working of mind experimentally and physiologically, as well as by introspection.

Matter, life, and mind are stated to be three ultimates which psychology can not explain. The hypotheses which philosophers hold in regard to them are classified as materialism, idealism, ideal realism, monism, and the popular one of matter and mind. The author considers that "there is no beginning place for mind anywhere" in the evolution of life, therefore the original cell must be psychic. The unfolding of the mental process is traced from the oxygen sense of bacteria and the sunshine quest of Desmids through plant life and animal life to the human brain. In this progress there are three marked steps—the appearance of protoplasm, the specialization of cells, and the co-ordinating of function. A study of the nervous system generally, and of its development in the various orders of life according to increasing complexity, complete the comparative view of the psychic factor.

In man we come upon the fact of consciousness. This is defined not as a name for a series of mental states, but as a recognition by mind of itself. It is held that even in the lower forms of life there may be "a

dim awareness of their psychic acts." Attention and the unchaining of mental states are given as the two functions of consciousness.

The author revels, however, in the realm of subconsciousness. Sleep, dreaming, somnambulism, hypnosis, thought-transference, lucidity, and hallucinations are so many doors by which knowledge may enter unhampered by sense. The consideration of criminality is given in the psychology of disease. Newspapers and novelists are justly arraigned for their responsibility in spreading the contagion of vice, and wholesome suggestions in regard to education are given.

Mind in detail is taken up in part second and begun by an outline of the evolution and action of the sensory and motor end organs. In the thirty-first chapter an analysis of the cognitive powers is first reached. The old-time division of the mental processes is retained as useful, though the mind is not endowed with any faculties, these being only different phases of psychic action.

It is a little to be wondered at that the author of this work merely enumerates the name of Comte in a list of materialistic philosophers whose theories are annihilated, yet employs the well-known Comtian law to describe the progress of the sciences, including psychology. Blank ignorance is made to precede the theological, metaphysical, and positive stages, which are euphoniously called periods of superstition, speculation, and exactness.

The spirit of the book is claimed to be "strictly scientific" and its purpose "to embody the trustworthy results of safe thought." This aim appears to have suffered an eclipse in the following statements: "When mind and life depart in death, the matter remains, so far as science can discover, chemically and physically the same." What about the coagulation of the blood and the whole process of disintegration? Is organized and unorganized matter identical? Thought-transference is also declared to be "a subconscious gift" whose *demonstration* is recent; "correlated" with this is "the no less amazing *fact* of lucidity or second-sight" due to a supersensuous vision which discerns beyond the reach of any known organ. The clew to this rash advocacy seems to be that "this discovery removes from the theological doctrine of a divine inspiration the stigma of violating probabilities."

Accuracy is pronounced impossible; "all sciences have to be regularly readjusted every few years."

Barring the questionable science of these passages, the book is brimful of information and good advice. It is well arranged, clearly written, and can hardly fail to benefit as well as to attain popularity.

PRACTICAL WORK IN GENERAL PHYSICS. By W. G. WOOLLCOMBE, M. A., B. Sc. New York: Macmillan & Co. Pp. 83. Price, 75 cents.

A COURSE of fifty experiments is provided in this little manual, comprising measurements of lengths, areas, and volumes, determinations of the density of solids, liquids, and a gas, the use of hydrometers and barometers, and a few relating to the pendulum and capillarity. Considerable attention is given to careful measurement, the sliding callipers, micrometer screw-gauge, the chemical balance, and the opisometer being used, with a vernier attachment wherever it is applicable.

LECTURES ON THE DARWINIAN THEORY. Delivered by the late ARTHUR MILNES MARSHALL. Edited by C. F. MARSHALL. New York: Macmillan & Co. Pp. 236. Price, $2.25.

THIS volume consists of a series of lectures delivered by the late Prof. Marshall in connection with the extension lectures of Victoria University during 1893. The author having failed to elaborate them and prepare them for publication himself, not all the parts are written out in detail, and there is a consequent variability in the fullness of the text; nevertheless, having been delivered by one of Darwin's most earnest disciples, they are believed to form a useful introduction to the literature of Darwinism. They present the History of the Theory of Evolution; Artificial and Natural Selection; The Argument from Palæontology; The Argument from Embryology; The Colors of Animals and Plants; a review of the objections to the Darwinian theory; the origin of vertebrate animals and the descent of man; and a summary of the life and work of Darwin. The author, summarizing his own work, defines as the position which he has

endeavored to establish, that there are causes which have been in existence since life began that will account for the structure, life, and habits of man, and that have tended in this direction; but "whether there is anything further than this; whether man has other attributes, either peculiar to himself, or held by him in common with other animals; whether there are attributes that can not be explained by these laws, are questions with which science has nothing to do."

PHYSICAL LABORATORY MANUAL. By H. N. CHUTE, M. S. Boston: D. C. Heath & Co. Pp. 213. Price, 80 cents.

THE author of this manual is not one of those who would teach physics through laboratory work exclusively. The pupil, he says, "should come to the laboratory well grounded in the first principles of physics as presented in some elementary treatise on the subject, and well read, especially, on the subject that he is to investigate, both as to mode of conducting the work, and manner of observing." Leaving the laws and principles of the science to be presented in a separate volume, this manual gives only directions for experiments. These directions consist regularly of a brief statement of the problem, a list of the apparatus required, the details of what is to be done, under the heading Method, and a tabular form of record. Sometimes the statement of method is supplemented by remarks. Cuts showing the proper arrangement of apparatus accompany the directions in many cases. Prefixed or appended are aids for both pupil and teacher relating to the management of the work, and making and manipulating apparatus, also many tables for reference. The book is adapted to pupils of high schools and academies.

SCHOOL ENGLISH. By GEORGE P. BUTLER. American Book Co. Pp. 272. Price, 75 cents.

THE increased attention which is now given to the study of English in secondary schools has stimulated the production of rhetorical text-books as well as the republication of English classics.

Some knowledge of rhetoric is plainly a necessity, not only in order to analyze the beauties of the masterpieces of literature, but that the pupil may recognize the faults in his own composition. The newer manuals which have been prepared for this purpose give too many regulations and a superfluity of extraneous matter. The author of this work, an experienced teacher, considers that twenty rules are sufficient to fortify young writers against common mistakes in construction. He succeeds not only in simplifying these directions, but in the chapter on Clearness, Force, and Harmony, furnishes some excellent drill in a neglected quarter. The exercises suggested in reproduction, substitution, and condensation should also prove helpful in paving the way for essay writing.

We do not understand, however, why the student is directed to look up *indecided* in the International Dictionary and observe its use when the word is not to be found there. Possibly it is a colloquialism known to the author and unrecorded by the makers of the lexicon.

The aim of the book is given in a quotation from Herbert Spencer's Philosophy of Style, "to enable the student to present his ideas in such language that they may be apprehended with the least possible effort"; and it is not too much to say that he must be indeed a dull scholar who is not materially helped toward this end by a faithful following of the principles here inculcated.

A LABORATORY MANUAL OF PHYSICS AND APPLIED ELECTRICITY. Arranged and edited by EDWARD L. NICHOLS, Professor of Physics in Cornell University. Vol. II. Senior Courses and Outlines of Advanced Work. New York: Macmillan & Co. Pp. 444. Price, $3.25.

THE student who has completed such a course of laboratory study in physics as is presented in the first volume of this work will be prepared to take up the problems for original research given in the volume now issued. The needs of students who intend to become electrical engineers have been especially consulted in those parts of Volume II dealing with applied electricity, heat, and photometry. There is also a fourth part, of a hundred and fifty pages, consisting of exercises in general physics. The student who essays this course of experiments "is supposed to be familiar with the general principles of electrical measurement, and to have had such experience in adjust-

ing instruments and practice in manipulation that he is ready at the start to investigate the operation of electrical apparatus." The following titles of experiments will give an idea of the sort of problems proposed: Comparison of magnetization curves of dynamos, characteristics of the Waterhouse dynamo and study of third-brush regulation, calibrating a voltmeter, effects of speed variation with a series dynamo, photometry of the arc light, specific heat of a liquid, influence of temperature upon the color of pigments, spectrophotometry, exploration of the earth's magnetic field. In preparing this volume, Prof. Nichols has had the cooperation of Messrs. George S. Moler, Frederick Bedell, Homer J. Hotchkiss, and Charles P. Matthews.

AN INTRODUCTION TO STRUCTURAL BOTANY. By DUKINFIELD HENRY SCOTT, F. L S., F. G. S. London: Adam and Charles Black. New York: Macmillan & Co. Pp. 281. Price, $1.

THERE is a touch of irony in the preface to this volume that is too good to be lost. The author observes, "If science is to be taken seriously, it rather seems desirable that those who study it should have to use their brains as much as in learning Euclid, algebra, or grammar."

Although it is often urged in behalf of scientific study that its disciplinary effect equals that of drill in the classics, the notion is wonderfully prevalent, even in this country, that a knowledge of science may be imbibed in a haphazard fashion without much application.

A little investigation of such a book as this will tend to convince the aspirant for mental exercise that as much of it is involved in becoming precisely acquainted with one flower as in mastering a chapter in Greek.

With the exception of a dissertation on the physiology of nutrition and an introduction explaining simple botanical terms and divisions, the whole volume is devoted to a consideration of three floral types, the Wallflower, the White Lily, and the Spruce Fir. These higher plants are chosen, not only because they are familiar forms, but also since they exemplify the division of labor and give an opportunity to become acquainted with the more specialized organs and their functions. The vegetative and reproductive organization of each, their external characters and internal structure, are minutely described. The phenomena of pollination, fertilization, the chemistry of the nutritive process and protoplasmic movements, are traced out in like fashion and the mysteries of plant life unfolded.

In method, arrangement, and language the book is altogether commendable. It is also well illustrated and contains an index. The addition of a glossary might be suggested, as likely to prove convenient to the young student.

BIOLOGICAL LECTURES. MARINE BIOLOGICAL LABORATORY OF WOOD'S HOLE. Boston: Ginn & Co. Pp. 242. Price, $2.15.

THIS volume is the second of a series, the first of which appeared in 1890. Like its predecessor, it does not include the general course of lectures given at Wood's Hole pertaining to the work pursued, but indicates special lines of inquiry involving unsettled problems.

Necessarily different points of view are developed, and the reader can test whether he believes fully in the cellular theory as expounded in The Nature of Cell Organization or in its inadequacy as presented by Prof. Whitman, who quotes from Huxley's essay of 1853 that the cells are no more producers of vital phenomena than shells on the sea beach, marking only where vital tides have been.

A valuable and interesting paper also is that on physiological morphology, in which the author, Jacques Loeb, maintains that all life phenomena are determined by chemical processes.

On the other hand, in Dynamics in Evolution, we learn that natural selection is a mischievous metaphor; that morphologists and physiologists are on the wrong track and can not settle the greater questions in biology. Surface tension is the important factor in the shaping of the cell, and the changes in amœboid form are understood only by dynamical analysis. No progress can be made in regard to the meaning of life until speculation about germ plasm or a lot of biophores, plastidules, *et sic*, superintending the business of development is abandoned.

Two popular and attractive essays are

those on the external conditions of plant life and the marine biological stations of Europe. The book is well illustrated and contains an appendix upon the work of the laboratory.

PREPARATORY PHYSICS. By WILLIAM J. HOPKINS. New York: Longmans, Green & Co. Pp. 147.

THE author of this laboratory manual is Professor of Physics in the Drexel Institute, Philadelphia, and the course of experiments here presented has grown out of the needs of his classes in beginning their study of the science. The greater part of the experiments relate to mechanics, for the author regards this subject "as being fundamental, particularly susceptible of treatment in this manner, with comparatively simple apparatus; and because the student is very greatly aided in thoroughly comprehending its problems by investigating them experimentally." Besides mensuration, the matters investigated under the head of mechanics are the composition of forces and of motions, levers and pulleys, breaking strength of a wire, deflection of beams, the inclined plane, the pendulum, etc. The properties of liquids are quite fully illustrated, and the book includes also a few experiments on heat, sound, light, and magnetism. The author maintains that only quantitative work is of value to the beginner in physical experimentation and he prefers to avoid those subjects in which only discouragingly inaccurate results are obtainable with the methods and apparatus that the beginner can use.

MANUAL OF PHYSICO-CHEMICAL MEASUREMENTS. By WILHELM OSTWALD. Translated by JAMES WALKER, Professor of Chemistry in University College, Dundee. New York: Macmillan & Co. Pp. 255. Price, $2.25.

DR. OSTWALD has now added to his valuable chemical works one on the border land between chemistry and physics. It deals with microscopic measurements of length, accurate weighing, the use of thermometers, thermostats, and calorimeters, of barometers and manometers, processes for determining volumes and densities, optical and electrical measurements, determinations of solubility, etc. The author confesses to "a special pleasure in 'pottering' and making things for myself," and urges his fellow-workers to adopt the practice of working with homemade apparatus. To facilitate their doing so he includes in this volume directions for making a logarithmic slide-rule, for marking scales on glass, and for soft and hard soldering, giving also a special chapter on glass-blowing. By these means he has "striven to combat that helplessness nowadays so prevalent among experimenters, who have to resort to the mechanic for every trifle." A section on weight-testing and several tables have been reprinted by permission from Kohlrausch's Physical Measurements. The tables in the volume comprise only those that are absolutely essential, the work of Landolt and Börnstein being referred to for all others.

A commendable feature in the *System of Physical Culture*, prepared expressly for public-school work by *Louise Preece* (C. W. Bardeen, Syracuse, N. Y.), is that every exercise can be taken by the pupils when standing in the aisles beside their seats. The conditions are prescribed for the exercises that the work should be such as will appeal to the sense of the beautiful, combining strength and freedom of movement; that it must be such as can be done by the pupils in the schoolroom within the usual limitations of space and time; that the movements shall be such as can be conducted in a systematic, orderly manner, without causing confusion; and that they must be such as do not demand a change of dress. The directions are analyzed and arranged by Louise Gilman Kiely, of the University of Minnesota, and illustrated by the author with 180 graceful half-tones and 50 cuts. (Price, $2.)

In his paper on the *Status of the Mind Problem*, selected from a course of lectures delivered before the Anthropological Society of Washington, *Lester F. Ward* compares the old metaphysical and the modern scientific methods of mind-study, and argues in favor of the latter. In this method mind is considered as an attribute of the physical structure. If the charge of materialism is applied to this view, the author answers that, using the word materialism in its only proper and legitimate sense as postulating the material nature of the mind itself, "the scientific conception of mind is the farthest

possible remove from a materialistic conception. The antithesis between matter and property is absolute." But, if the other view is accepted, that there is an element—mind, thought, or spirit—"that can detach itself from the personality to whom it normally belongs, or remain in space performing mechanical operations upon material objects," it is difficult to see how the charge of materialism can be avoided.

The Political Ethics of Herbert Spencer is the substance of a paper submitted to the American Academy of Political and Social Science, in which the author, *Lester F. Ward*, presents the results of his careful examination of Mr. Spencer's works, in a review criticising and impugning the more prominent features of his ethical system. His sociological system is declared to "proceed from so low and so narrow a standpoint as to constitute a protest against all attempts to deal scientifically with the subject," and it is pronounced "astonishing that the great exponent of the law of evolution in other departments should so signally fail to grasp that law in this highest department"; and, instead of carrying his system up symmetrically and crowning it with the science of man, he is said to have "tapered it off and flattened it out at the summit."

The Magazine of Travel is a new monthly publication which will be devoted to articles and discussions relating to travel in its broadest sense. The publishers promise that each number will be an improvement upon its predecessor. The first number, January, 1895, has articles on American and Foreign Travel Compared, by Hon. Chauncey M. Depew; Mexico: its Attractions for the Tourist, by E. H. Talbott; The New Education, by Edwin Fowler; A Summer in Alaskan Waters, by W. G. Cutler, United States Navy; Christmas on the Limited, a story, by Frank Chaffee; The Mountain Paradise of Virginia, by Charles D. Lanier; Hunting in the Cattle Country, by the Hon. Theodore Roosevelt; and In Southern California, by G. M. Allen. (The Magazine of Travel Publishing Company, E. H. Talbott, President and Manager, 10 Astor Place, New York; 25 cents, $3 a year.)

The results of *M. H. Saville's* studies of the *Ceremonial Year of the Maya Codex Cortesianus*, as summarized by him in a paper read before the American Association, are that there was a time series of two hundred and sixty days, divided into thirteens, beginning with 1 Imix, and making a sacred ceremonial year; that the glyphs in the part of the codex relating to this series are to be read from left to right through a series of pages in an alternating manner; that the pictures and glyphs accompanying this time series explain ceremonies that were to take place at intervals during the ceremonial year; and that the coincidence of a sinistral circuit of glyphs perhaps indicates the quarter in which ceremonies were observed during the last four days of the year. The author hopes that his paper may accomplish at least so much as to indicate a fruitful source of investigation for students of the Maya codices in studying the pictures and glyphs associated with this time series.

A Practical System of Studying the German Language is designed by the author, Dr. *Albert Pick*, for the use of physicians and medical students in self-instruction. It is observed that while one can learn by the aid of the usual text-books to converse in German about everyday affairs or to read literary German, or may become acquainted with the details of the grammar, none of them are competent to assist him in reading medical books, conversing with patients, or listening to medical lectures. The present system is for teaching the German medical language, and accustoming him to the long, coherent sentences used in medical treatises, talks, etc. It consists of short essays on anatomy, physiology, pathology, medical and surgical diseases, examination of patients, etc. Each lesson is in two parts; one being a short essay on the subject in "medical German," and the other a conversation on practical everyday subjects. A few lessons are given in applied or practical grammar alone. A key to the pronunciation and a translation accompany every word, wherever it appears. The work is in twelve paper parts, convenient to be put in the pocket, so that it may be carried along and consulted at any time or place. (Published by Pick & Tanner, Newtonville, Mass.)

The *Sixth Annual Report on the Statistics of Railways in the United States* of the *Interstate Commerce Commission* represents the year ending June 30, 1893, and is distributed

nearer the date to which it applies than any previous statistical report issued by the commission. It might be prepared still earlier, except for the fact that the railways are dilatory in handing in their returns. The railway mileage in the United States at the date of closing the report was 176,461 miles, showing an increase during the year of 4,897½ miles, or 2·80 per cent. This rate of increase as compared with the corresponding rates for previous years shows that the railway construction of the year stood below the average of construction for the six preceding years, but was in excess of the rate for the accounting year immediately preceding. The report is a solid mass of facts and figures tabulated to a very great extent, relating to all sides of railway construction, operation, service, and finance; equipment, men employed, capitalization and valuation of property, public service, earnings and expenses, and accidents. The commissioners close the report with recommendations that express companies, owners of rolling stock, depot property, stock yards, and the like, and carriers by water, connected with railway interstate traffic, be required to make reports to the commission.

With *The Play of the Planets*—a mechanical chart or revolving card, on which are depicted the phases of the moon, certain planetary elements, the zodiac, and the days of the month—by the aid of the *Book of the Play*, one may learn to cast his horoscope. The book of which, as well as of the game, F. E. Ormsby is the author, by way of illustration casts the horoscope of "Baby Esther," who was born September 9, 1893. The work is described as "a game, amusing and instructive," and in conformity with this a number of games are given which may be played in the social circle; and it is as much for purposes of amusement as of astrology that the "play" is constructed. (Planetary Publishing Company, Chicago. Price, $1.)

Mr. *Ormsby* is also editor of a new monthly periodical, *Planets and People*, "devoted to the science of occult forces, astronomy, vibration, magnetism, life, and the mystery of worlds, suns, and systems," which is published by Ormsby & Sprague, Chicago. It will give the first half of each number to articles and sayings of leading minds and thinkers in the occult realms of investigation, while the rest will embrace plain astronomy, occult astronomy or astrology, both the heliocentric and geocentric systems, physiology, anatomy, phrenology, physiognomy, etc.

The *Sixth Annual Report of the Agricultural Experiment Station of Cornell University*, besides the report of the director, *I. P. Roberts*, contains the reports of the treasurer and chemist, the botanist and arboriculturist, the cryptogamic botanist and plant pathologist, and the entomologist, agriculturist, and horticulturist, and an appendix of twelve bulletins, to which special attention is called as containing matter of prime importance. The year's investigations embraced a large amount of practical and scientific work; and the quality of the work is represented as steadily improving. A glance at the bulletins, without having time to examine them carefully, seems to confirm the director's estimate of them that they are of high scientific character, and will be exceedingly useful to the farmers.

The periodical *Our Animal Friends* is much more than the organ of the American Society for the Prevention of Cruelty to Animals, and publishes so much matter of varied interest relating to natural history and the ways and doings of animals, with anecdotes of animals and stories, with general information, and handsome illustrations as to make it a very attractive magazine for children and the family. The twenty-first volume—September, 1893, to August, 1894—comes to us handsomely bound and fitted to adorn equally the library shelves or the table.

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POPULAR MISCELLANY.

Meeting of the Geological Society in Baltimore.—The seventh annual meeting of the Geological Society of America was held at the Johns Hopkins University, Baltimore, Md., December 27th to the 29th. About sixty fellows of the society were present, and fifty papers were read. Prof. T. C. Chamberlin, in his address as the retiring president, spoke of his observations during the past summer on the glaciers and ice sheet of Greenland, especially of Inglefield Gulf and of Bowdoin Bay, a fiord extending from that gulf northward to Lieutenant Peary's winter station. A series of very instructive lantern views of these glaciers was exhibited after this address. The surface of Inglefield Gulf, at its far northern latitude of 78°, lying twelve hundred and fifty miles north of the southern end of Greenland and only about eight hundred and fifty miles from the pole, was mostly frozen during all last summer; and it was with much difficulty that the stanch steamer Falcon, bearing this Peary Relief Expedition, cut its way through the ice pack in August to reach Bowdoin Bay. Because the sun's rays there fall so slantingly, their effect to promote the flow of the glaciers is very slight, the maximum rate of the glacial currents being found to be only two and a half feet a day in midsummer; but the reflection of the solar heat from the ground at the ice margin causes the ends of the valley glaciers and the border of the great inland ice sheet to have a very steep slope, or even in many places a precipitous and sometimes overhanging front. In these ice cliffs, rising abruptly one hundred to two hundred feet or more, the lower half of the ice incloses much englacial drift and is very distinctly laminated, having obtained a nearly horizontal or often steeply inclined stratification through the shearing effect of its motion in the upper and central parts being faster than below. As the bowlders and smaller rock fragments are carried onward in the ice, they are thus subjected to much wearing upon each other. At some localities this englacial drift is being amassed beneath the ice border in low, rounded hillocks, nearly like the drumlins or oval hills of till so well developed about Boston, in central New York, and in some other districts of the northern United States and Canada, which have long puzzled glacialists to explain how they could be formed. Other glacial papers were presented at this meeting by Prof. G. Frederick Wright, on his observations last summer in a second expedition to Newfoundland, Labrador, and Greenland; by Prof. C. H. Hitchcock, on deposits regarded as deltas of a glacial or ice-dammed lake in the basin of Lake Memphremagog, the old water level having been about four hundred feet above that of to-day; by H. F. Reid, on the secular recessions and readvances of the present glaciers of the Alps and other regions; by Warren Upham, on the question whether the ice sheets of the Glacial period were formed chiefly by snowfall upon all their area or advanced far beyond their zone of predominant snow accumulation, and a second paper on the climatic conditions shown by North American interglacial deposits; and two papers by Prof. H. L. Fairchild, on the lakes held by the barrier of the waning ice sheet in the valleys of the Finger Lakes, the Genesee River, and other streams in central New York. Prof. Fairchild, from observations made principally during the past year, maps and names fifteen or more of these lakes. They range from ten to thirty miles in length and from two to five miles in width, with outlets across the southern watershed to the head-streams of the Susquehanna. In the long and deep valleys now occupied by Canandaigua, Keuka, Seneca, and Cayuga Lakes, the former glacial lakes stood four hundred to seven hundred feet above the present lake levels, as shown by the old deltas and shore lines. Papers on the crystalline rocks of Archæan or pre-Cambrian age were presented by C. W. Hall, F. D. Adams, J. F. Kemp, C. H. Smyth, Jr., W. S. Bayley, and others. The folded structure of the Appalachian mountain belt was

discussed by Arthur Keith; and the same type of mountain-folding was described by C. D. Walcott in the White Mountain range of Inyo County, Cal. Other papers on the Paleozoic rock series, and on their fossils, were by N. S. Shaler, H. P. Cushing, C. R. Keyes, H. S. Williams, David White, and Dr. Robert Bell. Mesozoic formations in Arkansas were described by G. K. Gilbert and F. P. Gulliver; in Montana, by W. H. Weed and L. V. Pirsson; and in Maryland and New Jersey, by W. B. Clark and N. H. Darton. Coming down to the present time in the geologic record, the Tertiary and Quaternary formations of New Jersey were reviewed by R. D. Salisbury; and the history of the island of Cuba during these eras was traced by J. W. Spencer. About a dozen other papers were on observations in petrography and mineralogy. The officers elect for the year 1895 are Prof. N. S. Shaler, Cambridge, Mass., president; Prof. Joseph Le Conte, Berkeley, Cal., first vice-president; Prof. C. H. Hitchcock, Hanover, N. H., second vice-president; Prof. H. L. Fairchild, Rochester, N. Y., secretary; Prof. I. C. White, Morgantown, W. Va., treasurer; Mr. J. Stanley-Brown, Washington, D. C., editor; and Mr. R. W. Ells, Ottawa, Canada, and Prof. C. R. Van Hise, Madison, Wis., new members of the council.

Prof. Sully's Inquiries.—Prof. James Sully, being about to issue a new and revised edition of his Teacher's Handbook of Psychology, and desiring to make it as useful as possible to teachers, invites suggestions as to the directions in which the book might be improved. He would also be glad to receive striking observations of children's mental characteristics as they reveal themselves under the processes of education, and fresh illustrations of the effects on the young mind of methods of teaching which accord with the principles laid down, and still more of those which conflict with them. These observations may relate to the ignorances of children, their preconceptions and prejudices, the special directions of their observation and interest, their customary lines of mental association (sequence of ideas), their ways of interpreting language, their modes of judging and reasoning about things, their sensibility and insensibility, and their attitude toward moral discipline. Illustrations are also desired of the practical bearing of principles, and more especially of the evils resulting from the neglect of them. Mr. Sully's address is East Heath Road, Hampstead, London, N. W. Communications should be sent before the end of April, 1895.

Disinfection of Scarlet-Fever Patients.—Experiments by Dr. William Gibson, of Campbeltown, Scotland, in disinfecting scarlet-fever patients so as to free them from contagion before the process of desquamation is completed, have resulted successfully. His method was to give a succession of three or four comfortably warm baths, sometimes daily, at other times on alternate days, using freely carbolic-acid soap, and washing the patient thoroughly from top to toe. After each bath, except the last, the patient was put back to the bed on which he had lain with the disease. After the last bath he was taken into a clean room, dressed with clothes free from infection, and then allowed to mingle with the rest of the family. In most cases the body was anointed daily with olive oil mixed with some disinfectant. Patients with such complications as otitis or ulcerated or suppurating throat were not subjected to the process. No complications followed the cleansing process in any case; but convalescence seemed to be rather hastened than retarded.

The Elements of Speech in the Kindergarten.—Drill in the sounds that make up words is suggested by Mrs. E. B. Burnz as a proper and profitable exercise for the kindergarten. Her idea is set forth in three articles that appeared in the Kindergarten News in the course of 1894. Few pupils or teachers in the ordinary schools realize that every word is composed of sounds into which it may be divided. Practice in making the separate sounds, combining them to form words, and separating words into their phonetic elements would greatly facilitate correct and ready enunciation both in speaking and reading. Many parents are much distressed because their children, when of kindergarten age and older, can not speak plainly. Such phonetic drill would be of great benefit to these children. The idea by no means involves the introduction of read-

ing into the kindergarten—the instruction should be wholly oral. The children should be led to grasp the idea that each sound is produced by a special shape of the mouth. In learning to put the mouth into the various required shapes they get a control of the muscles of the tongue and other vocal organs. Mrs. Burnz gives some further details and suggestions, including the words of a "Vowel Song."

An Aquatic Biological Station in Illinois.—The Aquatic Biological Station of the University of Illinois and the Illinois State Laboratory of Natural History, at Havana, on the Illinois River, is especially devoted to the study of the effect on the aquatic plant and animal life of a region produced by the periodical overflow and gradual recession of the waters of great rivers, and is believed to be, in some respects, the only station of its kind in the world. The station, with the river varying in width from five hundred feet to four or five miles, according to the stage of the water and the outlying lakes, is excellently adapted to this purpose. The results of the first season's work are only a beginning, but they dimly reveal a large number of problems for which solutions may be sought. Notable contrasts in kind and number appear between animals of the springy shore and lake and those of the muddy intervale, only a few rods away on the other side, between river and lake, and between different lakes—contrasts easily comprehensible, as in the first instance given, where the cool spring water flowing in abundantly is evidently favorable to the gammerids and aselli swarming there, and sometimes peculiarly puzzling, like that between Quiver Lake, on the one hand, whose waters were densely choked in midsummer with a thick growth of aquatic vegetation, but contained fewer of the smaller animal forms than the open current of the river, and Thompson's Lake, on the other hand, where the water was relatively clear of aquatic plants, but abounded in rotifers and entomostraca. Still more curious was the contrast between the similarly situated and very similar lakes, Quiver and Matanzas, the waters of one loaded and clogged with plants and swarming with small mollusks and insect larvæ, and those of the other with hardly a trace of even microscopic vegetation, and with a correspondingly insignificant quantity of animal life. The course of events in a body like one of the station's lakes, with its extreme seasonal vicissitudes, ranging from complete overflow and loss of identity to absolute drying away in now and then an exceptional year, is extremely interesting to the œcologist. "The extraordinary instability of the system, one predominant and excessively abundant from quickly following another almost to the suppression of its predecessor, and all finally overwhelmed in a common doom, gives to the student an impression of an unhealthy organism, caught in the trap of an unfavorable environment, and hurrying through the stages of a fatal disease. One of the surprises of the season was the abundance of life in the main stream, which, as already intimated, sometimes contained a greater abundance of animal forms than most of the lakes connected with it; and another was the relatively small difference between the animals frequenting widely unlike situations in the same body of water." The freshness and fruitfulness of the field were well illustrated by the large number of new forms found, especially among rotifers, worms, and insect larvæ.

The Valley of Hadramaut.—Mr. Theodore Bent lately gave the Royal Geographical Society an account of an expedition which he and his wife had made to Hadramaut, a broad valley running for a hundred miles or more parallel to the coast of Arabia, by which the valleys of the plateau discharge their water into the sea at Saihut. Because of the fanaticism of the inhabitants, this main valley had been reached by only one European before Mr. and Mrs. Bent—Herr Leo Hirsch, in 1893. Mr. and Mrs. Bent traveled without disguise, and with a large retinue of followers. The country is inhabited by several classes of people: wild tribes of Bedouins, who do all the carrying trade, possess large tracts of country, and are a terror; the Arabs proper, who live in the towns and cultivate the lands around them; the Seyyids and Sherifs, the Arabian aristocracy, being descendants of the Prophet and possessing enormous influence; and the slave population and freed slaves. There is no source of wealth in the country, but great

luxury prevails among the aristocracy. It comes from India, where it was acquired. The architecture of the towns is decidedly monotonous. Most of the houses are exceedingly high, many of them reaching eleven stories. They are built of sun-dried bricks, and are externally decorated with chevrons and zigzag patterns. There is always a terrace on the roof, where the people sleep in the hot weather, and they are usually decorated with turrets, domes, machicolations, buttresses, etc., which give them quite a mediæval appearance. Outside in the courtyard the flocks and herds are kept, and the horses are stabled at night. The lower story is devoted to the storage of goods, the second story is inhabited by servants, the third by the guests, and above that come the harem and the family dwelling rooms. Excellent carvings are executed on the parts of the buildings convenient for them, and on the household utensils. Sultan Sallah was much taken with Mrs. Bent's accomplishments, because she could do other things besides paint herself with turmeric and antimony, and lead a listless life of seclusion and squabbles in the harem. The medical condition of the country is terribly deficient. Burning the part affected with a hot iron is a favorite remedy, called *kayya*, and was seen frequently applied. The doctors consider certain smells dangerous for certain wounds, and those afflicted are obliged to wear stoppers in their noses for fear of inhaling the odor. On to a wound they will tie iron or tin; and, as women are not allowed to see medical men, their husbands take a hair from their head, by which the doctors undertake to decide from what the lady is suffering. Sultan Sallah told a curious case which had come under his notice: A man, for a wager, ate all the fat of a goat, and when he was subsequently taken ill, the doctor ordered a fire of wood to be lighted all round him to melt the fat, which had congealed in his inside.

The Composition of the Primitive Atmosphere.—Contrary to the usual doctrine that the proportion of oxygen in the atmosphere is decreasing and that of carbonic acid is increasing, a theory was put forth by the late Prof. C. J. Koene, of the University of Brussels, that the proportion of carbonic acid was formerly vastly greater than it now is, while oxygen was absent from the primary atmosphere. Force was added to these conclusions by the luxuriance of the coal plants and by the frequent presence of combustible substances, such as pyrites, molybdenite, and copper pyrites, in the primitive rocks. Under this hypothesis the origin of the oxygen in the atmosphere should be sought in the activity of plant life, decomposing carbonic acid and evolving the life-giving element. In the examination of this theory, Dr. T. L. Phipson has made experiments to ascertain to what extent our modern plants can vegetate in atmospheres of carbonic acid, hydrogen, and nitrogen. Taking such plants as pea, myosotis, antirrhinum, and convolvulus, he found that they could exist for many days, and even weeks, in an atmosphere of pure carbonic acid, but did not thrive; that they appeared healthy in an atmosphere containing so much carbonic acid that an animal exposed to it would perish in a few minutes; and that they flourished remarkably well in an atmosphere containing one hundred times as much carbonic acid as in its normal condition. Convolvulus and antirrhinum in an atmosphere of pure hydrogen were healthy, while the hydrogen gradually disappeared, probably by uniting with the nascent oxygen, and the plants got covered with water. In an atmosphere of pure nitrogen vegetation was remarkably healthy for a lengthened period, and in one of carbonic acid and nitrogen mixed it was truly luxuriant. Dr. Phipson found, moreover, that the lowest orders of microscopic plants separate oxygen from its compounds—carbonic acid and water. He concludes that, primarily, when the heat was so intense that no compounds could exist, the earth was in the state of free elements, or of atoms all identical, which became differentiated as the cooling went on; that the primitive atmosphere consisted of nitrogen, into which volcanic action poured large quantities of carbonic acid and water; that free oxygen, not at first present, was supplied by the evolution from the first organic beings—plants—that appeared, they deriving it from the carbonic acid they found in the soil and the atmosphere. This oxygen, poured into the air for an incalculable series of ages, has gone on increasing in quantity from the earth's earliest history to the present time; and when it had attained to a certain amount, animal life

became possible, and duly appeared (in its lowest forms). As the oxygen became more abundant, animal life of a higher order became possible. The development of the nervous system has coincided with the increase of oxygen in the air.

Place of the Free Academy.—Describing the place of academies in the State school system of New York, Principal William E. Bunten said at the University Convocation that the free academy is a democratic institution in the best sense of the word democratic. It is there that the great bulk of successful business men receive all the training and discipline they ever get in school above the elementary branches; and an increasingly large number pass directly from the academy to the study of law and medicine. The great majority of teachers get their only preparation in the academy, either with or without training classes. Again, "many a boy or girl receives in the academy an inspiration, a sort of mental momentum" that sends him to college—a thing he never would have thought of had not the free academy existed; and many a parent is able to give a son or a daughter a collegiate education because the same academy saves the expense of three or four years at the preparatory school, and at the same time keeps the child under the wholesome influences of home during these early formative years. The place of the academies is, then, "to prepare what may be called the great middle class to enter on their several vocations in life, and to place golden opportunities before the youth of all classes, rich and poor alike."

The "Hot Winds" of the Plains.—An instructive study of the summer "hot winds," with which the great plains are occasionally visited, has been published by I. M. Kline, based on a comparison of the recorded observations of about twenty years. These winds are likely to occur between May 15th and September 15th, but are most frequent during July and August; they are extremely dry; their direction corresponds with that of the general movement of the atmosphere at the surface of the earth at the time; the region of the atmosphere in which they occur has a progressive movement from west to east; and they occur mostly with low-pressure areas, which have moved slowly from the north of Montana southeasterly along the eastern slope for three or four days before they take up a decided movement eastward—although this condition is subject to variation. A striking characteristic of them is their effect on vegetation, which they always cause to wilt and droop, while the more intensely hot winds burn vegetation to a crisp in a few minutes, without relation to the amount of moisture present in the soil or general atmosphere. The opinion that there is a special class of these winds, that the heat and dryness are of dynamic origin like that of the foehn and chinook, has been advanced by some, and the present study of all the observations and correlated facts relating to the subject seems to confirm this view. Although the development of these hot winds is wholly independent of drought conditions, they will, of course, become much more intense, extend over more territory, and be more injurious to crops when they occur during the prevalence of a drought than when they occur with seasonable weather. The areas affected by them, while they make considerable show, are but a small amount when compared with the whole crop of a State. Occasionally one sixth or even one fourth of two or three counties are completely burned up, but such cases are rare. After a careful consideration of the subject, the author has come to the conclusion that while these winds are often very intense and striking in their nature and damage crops to a considerable extent, yet there are often parts of the United States where the farmer has as great drawbacks to contend with—such as overflows, excessive rains, etc. These winds are a feature of the climate of the eastern slope of the Rocky Mountains, and can not be expected to disappear or even become less frequent; neither are they likely to become more so. The best suggestion the author can make for lessening their injurious effects is to fence against them by hedges and plantations of timber.

Mechanical Work and Chemical Action.—Some very interesting experiments in the transforming of mechanical work into chemical action have been described by M. Carey Lea. Employing a shearing stress, he placed, in one series of experiments, a small quantity of a metallic salt in a mortar, spread it into

a thin uniform sheet over the bottom, and rotated the pestle with the utmost force he could command. Two or three decigrammes of chloroaurate of sodium left 1·8 milligramme of metallic gold. Under the action of the pestle the yellow color of the salt gradually deepened to an olive shade. When water was poured on, the undecomposed salt dissolved, leaving the gold as a delicate purple powder. Half an hour's trituration of half a gramme of the salt resulted in the reduction of 9·2 milligrammes of gold. By a similar operation corrosive sublimate was reduced to metallic calomel. Salts of mercury, platinum, and silver gave results analogous to those obtained with gold.

Value of Tradition.—When Jacques Cartier visited the St. Lawrence River in 1535 he found, where Montreal now is, a strong city exercising an extensive sway, named Hochelaga. When Champlain sailed up the same river, seventy years later, Hochelaga had disappeared and left no trace. The story of the fall of its dominion has never been satisfactorily explained. Mr. Horatio Hale, visiting the Wyandotte Indians a few years ago, found among them coherent traditions of their former residence in the east, and their withdrawal thence to settle near Mackinaw. The interpretation of these traditions, of which the author gives two versions, divested of what is fanciful in them, combined with a few known incidents, points to the expulsion of the Huron tribes from their stronghold of Hochelaga as the result of a war with other tribes of the Iroquois stock. From this lesson Mr. Hale draws important conclusions regarding the value of traditional evidence. "It is plain," he says, "that until recently this evidence has been seriously undervalued. Our students of history have been too generally a book-worshiping race, unwilling to accept any testimony with regard to events that is not found in some contemporary page, either written or printed. It is not half a century since a distinguished English author pronounced the opinion that no tradition can be trusted which is more than a hundred years old. At the time when this opinion was put forth by Sir George C. Lewis, many voyagers and missionaries in the Pacific islands were accumulating traditional testimony of vast and varied origin, which is now admitted on all hands to prove the occurrence of events that must have taken place at successive periods extending over the last two thousand years. The Brief History of the Hawaiian People, by Prof. W. B. Alexander, of Honolulu, published in 1891, 'by order of the Board of Education of the Hawaiian Kingdom,' recounts as unquestionable facts many voyages, migrations, battles, royal and priestly accessions, marriages, and deaths which have occurred in the Sandwich Islands and other groups, from the eleventh century to our own time. At the other extremity of the great ocean the Polynesian Society, established at Wellington, New Zealand, has published in its excellent quarterly journal communications from able contributors relating to various histories, and carrying them back, with the aid of numerous mutually confirmatory genealogies, for many centuries, with unhesitating belief in their general truth. In this way the history of the peopling of the vast Polynesian region, extending over a space larger than North America, and covering at least twenty centuries, is gradually becoming known to us as surely, if not as minutely, as that of the countries of Europe during the same period. The question naturally arises whether we may not hope to recover the history of aboriginal America for at least the same length of time. . . . We have every reason to feel assured that in the three hundred Indian reservations and recognized bands of the United States and Canada, with populations varying from less than a hundred to more than twenty thousand, and comprising many men and women of good education and superior intelligence, there are mines of traditional lore ready to yield returns of inestimable value to well-qualified and sympathetic explorers."

Mashona Granaries.—Grain is stored by the natives of Mashonaland in circular granaries, which are miniature copies of their own huts. Near the source of the Ingazuri River the railroad surveying party unexpectedly came across a collection of fifty or sixty granaries, belonging to a neighboring village, and in charge of two watchmen. "The clean surface of the granite rock formed the floor of the granaries; they were perched on bowlders, without regard to order, where a flat surface offered a favorable location.

Their circular walls consisted of wattle and daub; three or four stout poles with forked ends protruded above the rest of the wall to receive the ribs of the umbrella-shaped roof, this roof being first covered with a plastering of mud, and then thatched with long grass. Some of the granaries measured six feet in height to the eaves and six feet in diameter, but they varied in size to suit the area of level rock available on the several bowlders. The interior is partitioned, by walls of wattle and daub, into three or sometimes four compartments, to separate the bulk of the grain. The building is covered with an inner roof of sticks plastered into mud before the outer roof is put on. A small door or manhole made from an oval or round slab of rock, and with a handle fitted to it, is let into the wall of the hut about four feet above the ground. The outside ornamentation of nearly all the huts consists of moldings representing the female breast—an emblem of plenty—and a longitudinal bar in relief above them, the significance of which is open to conjecture. In the aggregate these granaries were capable of storing upward of six thousand bushels of grain."

Height of Ocean Waves.—Dr. G. Schott, studying the form and height of the waves of the deep sea, found that under a moderate breeze their velocity was 24·6 feet per second, or 16·8 miles an hour, which is about the speed of a modern sailing vessel. As the wind rises, the size and speed of the waves increase. In a strong breeze their length rises to 260 feet, and their speed reaches 360 or 364 feet per second. Waves, the period of which is nine seconds, the length 400 or 425 feet, and the speed twenty-eight nautical miles per hour, are produced only in storms. During a southeast storm in the southern Atlantic Dr. Schott measured waves 690 feet long; and this was not a maximum; for in latitude 28° south and longitude 39° east he observed waves of fifteen seconds period which were 1,150 feet long, with a velocity of 78·7 feet per second, or 46½ nautical miles an hour. Dr. Schott does not think that the maximum height of the waves is very great. Some observers have estimated it at 30 or 40 feet in a wind of the force represented by 11 on the Beaufort scale (the highest number on which is 12); and Dr. Schott's maximum is just 32 feet. He believes that in great tempests waves of more than 60 feet are rare, and that even those of 50 feet are exceptional. In the ordinary trade winds the height is five or six feet. The ratio of height to length is about 1 : 33 in a moderate wind, 1 : 18 in a strong wind, and 1 : 17 in a storm; from which it follows that the inclination of the waves is respectively about 6°, 10°, and 11°. The ratio of the height of the waves to the force of the wind varies greatly.

Climate of Galveston.—The advantages of the climate of Galveston, Tex., are well set forth in a paper by Dr. I. M. Cline. The city is situated on an island four miles from the mainland, in latitude 29° 17′ north, and has, therefore, a real insular climate. During twenty years the lowest temperature was below 20° only in two, while the highest recorded temperature is 98°. July is the only month in which the maximum temperature reaches 90° in every year. During August it has reached that point in eighteen years; during September, in eight years; during June, in four years; and during May, in three years. The highest monthly range is 58°, and the average diurnal range is 10° 5′. The amount of moisture in the atmosphere ranges between seventy and eighty per cent. There are on the average 133 clear, 140 partly cloudy, and 92 cloudy days in a year; and it is estimated approximately that the sun shines to some extent on 318 days in a year. The average annual death rate is about 15 per 1,000 inhabitants, consumption leading the list with one in fourteen deaths. No epidemic diseases, except a few cases of smallpox, have visited the region since 1870, and none of the more destructive epidemics have ever originated in Galveston.

Flameless Explosives.—A committee appointed in 1888 by the North of England Institute of Mechanical Engineers to investigate upon the subject of flameless explosives in relation to their degree of safety in mines, has only recently published the first part of its report upon experiments that were begun in 1892. They find that all the high explosives are less liable than blasting powder to ignite inflammable mixtures of air and fire damp. They can not, however, be relied upon as insuring absolute safety when used

at places where inflammable mixtures of air and fire damp may be present. The variable results following upon the detonation of high explosives appear to be due in some measure to defective admixture of the in gredients or variation in the properties of them. It is also certain that these explosives alter in character with age. The same precautions should be observed when they are used as with blasting powder; and it should always be recollected that the risk of explosion is only lessened and not abolished by their use. All the high explosives upon detonation produce evident flame.

Science Endowments in the United States.—Of the endowments for post-graduate scientific study in our colleges, Mr. Addison Brown, in his address before the Scientific Alliance of New York, shows that Columbia College has two fellowships—the Tyndall, of $648 a year, and the Barnard, of about $300 a year—expressly restricted to science. Besides these, twenty-four general university fellowships of $500 for post-graduate study have been established, of which eighteen are in present operation; and, in addition, the Schermerhorn fellowship in architecture of $1,300, and the two McKim fellowships, to support study in foreign travel, and five prizes for proficiency in the medical department. The University of Pennsylvania has the Tyndall fellowship and the Lea Hygienic Laboratory with a fellowship of $10,000 endowed by Thomas A. Scott, and at present applied to original research in bacteriology. At Harvard, besides the three Bullard fellowships of $5,000 each, established in 1891 to promote original research in the medical school, there are two post-graduate fellowships devoted to science exclusively, the Tyndall fellowship of about $500, and the income of the recently established Joseph Lovering fund, the principal of which is now about $8,000. There are also eleven other general fellowships—the Parker, the Kirkland, and the Morgan—available for promising graduate students in any branch, of which about five have usually been assigned to science. These fellowships give an income of from $450 to $700 a year. Harvard has also forty-six scholarships available for graduate students, varying in income from $150 to $300 each, of which about seventeen are assigned to science. Princeton has a hundred undergraduate scholarships, and only one post-graduate fellowship for science. Yale has the Silliman and the Sloane fellowships in science. In all these colleges there are only about twenty-six adequately endowed post-graduate fellowships in science. As these should be continued for at least three years, there is provision altogether for only about nine per year—not one fourth the number required to supply the annual loss of trained teachers in the colleges of the country, to say nothing of the increasing demand through the growth and improvements in the colleges themselves. As it is from such specially trained students that the great professors of the future must be drawn, the need of much greater endowments for new recruits is apparent.

Animals in Sleep.—Delicate distinctions are made by a writer in the London Spectator on the Sleep of Animals between those animals which sleep soundly, those which sleep fitfully and always on the alert, as if "with one eye open," and real nocturnal animals which sleep in the daytime a dead sleep. Rabbits, deer, and other timid animals, sleeping largely in the daytime, when wakened, instantaneously pass into the action that is required—usually flight and escape—with full possession of their faculties. "A sleeping fox will rise, gallop off, and dodge the hounds with as much coolness and knowledge of the ground as if it had been surprised on the prowl with all its wits awake. . . . Hares seem never to sleep; however closely they may lie in their forms, the eye is ever alert and vigilant. . . . Deer stalkers have discovered by experiment that the sleeping senses of the stag (hearing and scent) are sensitive up to a distance of at least two hundred yards on the windward side." There are reasons for believing that the broken and timid form of animal sleep in the greater number of species is not such as they would naturally choose, but is the result of habits acquired and transmitted in centuries of danger and avoidance of their enemies; and that the same causes that have modified the hours of sleep—changing them from the night time to the daytime—have also modified its character. They are not daytime and alert sleepers by

choice. Of such animals only a small fraction are night feeders by nature or choice. The real night feeders—bats, lemurs, lorises, etc.—are mostly insect-eaters, and their day sleep is sound, almost to lethargy—so that it is extemely difficult to disturb their slumber. Between these two kinds of sleep is the form enjoyed by the large carnivora and the domestic animals. Tigers and lions have no reason to be afraid of anything but man, and sleep soundly and carelessly. Yet they possess the power of vigilance in sleep, which they can use, if required. Domestic animals, under man's protection, sleep well, and usually wake deliberately. Dogs are drowsy or wakeful, and, according to their state of mind and circumstances, seem to sleep lightly or heavily at will. "Nothing can be more slow, reluctant, and leisurely than the enforced waking of a petted house-dog when it does not wish to be disturbed. It will remain deaf to a call, twitch its feet if tickled, but not unclose its eyes, and stretch and yawn like a sleepy child. But mention something interesting to the same dog when sleeping, such as the word 'walk,' or click the lock of a gun, and it is on its feet in an instant, and ready for enterprise." Even human sleep, this writer adds, "can be made vigilant by solicitude or previous resolve. It is a common experience that persons who are heavy sleepers can awaken at a certain hour by resolving to do so, or if roused by a sound previously agreed on recognize it as a call to awaken and do awaken instantly."

The Tanning School of Freiburg.—What is probably the only tanning school in the world—as distinguished from schools in which the chemistry of tanning is taught—was opened in 1889 at Freiburg, Saxony. Instruction is given in it in the theory and practice of the preparation of leather, in tanning, and in finishing. It is supported conjointly by the state, the city of Freiburg, and friends. It is attended by pupils from all parts of the world. It is completely fitted up with all the machinery and apparatus for tanning, and has rooms and machines for the unworked skins, lime baths, vats, cutting, rolling, and pressing. The machinery is all from the United States, and the director of the institution is an American tanner. Besides him, the teaching force includes a body of chemists, teachers, and a corps of practical tanners. The students give two hours a day—ten hours a week—in assisting at the operations of the tanners. Hides from all parts of the world are experimented upon every year, with all kinds of tanning processes, barks, and materials. The processes of the old and new schools are shown and compared; and it is said that the former give good and expensive, and the latter quick and cheap results. Lectures are given in the winter on subjects related to tanning; and excursions to tanneries, to the woods where the bark is collected, and to the yards where the bark is stored, are a part of the instruction.

NOTES.

The process of manufacturing calcium carbide by heating in an electric furnace a mixture of coal dust and lime is now well known. The appearance of this material, in masses, is like that of the mineral serpentine, it being greenish gray in color, with a luster like that of feldspar. If a few drops of water are thrown on this seeming rock, gas is given off, which, if ignited, burns with a brilliant flame, and will continue to blaze, if supplied with water, till the mineral is exhausted. It is proposed to use acetylene gas thus produced for local gas engines. A charge of the mineral is placed in a closed vessel in which a regulated supply of water is admitted. A little water entering evolves a quantity of gas, whose pressure shuts off the water, and, as the gas is exhausted, more water is admitted to renew the supply.

The fiftieth anniversary of the discovery of anæsthesia by Horace Wells was celebrated in Hartford, Conn., December 10th, by a meeting and banquet of about fifty dentists of the State. It was claimed by some of the speakers that there was now no question as to Dr. Wells's priority in the discovery; and the story of the early experiments was told by Dr. G. Q. Colton, whose administration of laughing gas fifty years ago suggested to Dr. Wells the idea of using it as an anæsthetic.

Mr. J. Gray read a paper in the British Association on the Distribution of the Picts in Britain, as indicated by Place Names. The Picti of North Britain and the Pictones or Pictavi of South Gaul are both mentioned by Roman writers. The evidence of place names shows that probably the whole intervening country was at an earlier date occupied by the same race. The language of the Picts was Basque. The name Pict is derived

from a Basque word—*pikatu*, to cut. Place names in the British Isles involving all forms of the root Pakat have been classified under counties and their densities calculated. The Goidels, who followed the Picts, spread along the valleys of the Thames and Severn to the Mersey, where a part probably crossed to Meath and spread in two streams to the west coast of Ireland; the other part moved northward, and advanced into Scotland almost to the Forth. A second incursion entered Scotland by Argyll and spread along the west counties to the extreme north. The pre-Pictish inhabitants were probably Iberians, and prevailed mostly in Ireland, South Wales, Cumberland, and South Scotland.

EXPERIMENTS made by different observers at different times and places, culminating with those of M. Kœchlin on the Eiffel Tower, indicate that the formulas used by meteorologists for the conversion of wind velocity into pressure give results about one third too high.

THE Pilot Chart of the North Atlantic Ocean, published by the Hydrographic Bureau of our Navy Department, shows that from the 9th to the 23d of November there were only two days of good weather. The system adopted by this bureau for collecting and discussing observations made at sea enables it to present the chart of the results very quickly.

IT has been found, after careful investigation, by Profs. A. Bartoli and E. Stracciati, of the absorption of solar radiation by fog and by cirrus clouds, that a veil of cirrus is able to intercept as much as thirty per cent of the sun's rays; while a slight fog, equally diffused in all directions, intercepted from fifty-eight to ninety-two per cent of the solar rays that would have been transmitted with a clear sky.

PROF. G. S. BRADY, after an examination of British fish-cultural establishments, has recommended the foundation of a hatchery on the Northumberland coast to aid in keeping up and improving the supply of sea fish, and of a biological laboratory attached to it for the scientific study of the marine fauna of the neighborhood.

IN a recent lecture before the English College of Preceptors on Science Teaching, Mr. H. G. Welles pointed out that a rational course of science should grow naturally out of the kindergarten. This should lead to object lessons proper, and demonstrations in physics and chemistry may be made to grow insensibly, without any formal beginning, out of such lessons. The best—about the only permanently valuable—preparation for a scientific calling that can be given to a boy in a secondary school is the broad basis of physics and chemistry led up to in this way.

OBITUARY NOTES.

THE Marquis Louis Charles Joseph Gaston de la Saporta, the eminent fossil botanist, and author of many brilliant books on his specialty, died suddenly at Aix, France, in the last week in January. He was born at Saint Zacherie in 1825; was nominated correspondent of the Institute of France in 1876. In his special field he was one of the most industrious students and eminent authorities of the day. Between his first book, on the flora of the Quaternary period, in 1876, and his Paleontological Origin of Cultivated Trees, in 1888, he published at least twenty volumes containing important facts and new discoveries. His last work was on the fossil flora of Portugal. "No one," says M. Albert Gaudry, himself an eminent paleontologist, "has cast so clear light on the history of the formation and successive developments of the vegetable world." The Monthly has been often enriched with translations of his brilliant and suggestive essays.

PROF. ARTHUR CAYLEY, the greatest English mathematician, and one of the most eminent mathematicians of any country or time, died in Cambridge, England, January 26th. He was born in Richmond, England, in 1821, and showed a great aptitude and liking at an early age for arithmetical calculations—although it was said of him in later years that he could not count the change for a shilling. He was educated at Cambridge, where he excelled all in mathematics, coming out as senior wrangler and first prize man in 1842; practiced at the bar for several years, without losing his taste or ceasing his devotion to mathematics; and was appointed to the newly instituted Sadlerian Professorship of Mathematics at Cambridge, in 1863, after he had already contributed about three hundred papers to the Royal Society. As a mathematician he is perhaps most famous as the discoverer of the Theory of Invariants, which, according to Prof. Salmon, has given a new aspect to several departments of the science. The Royal Society's list contains the titles of seven hundred and twenty-four papers and memoirs by Cayley, down to 1883, while the number now would probably be about eight hundred. Prof. Cayley was active and efficient in many other spheres than that of mathematics. He was an early member of the Alpine Club. He was familiar with many European languges. He delivered a course of lectures at Johns Hopkins University in the winter of 1882–'83. He was President of the British Association at Southport in 1883. He received the Royal and the Copley medals of the Royal Society, was an officer of the French Legion of Honor, and was an honorary member of many learned societies at home and abroad. His mathematical papers are in course of publication in a series of ten quarto volumes, of which seven have appeared.

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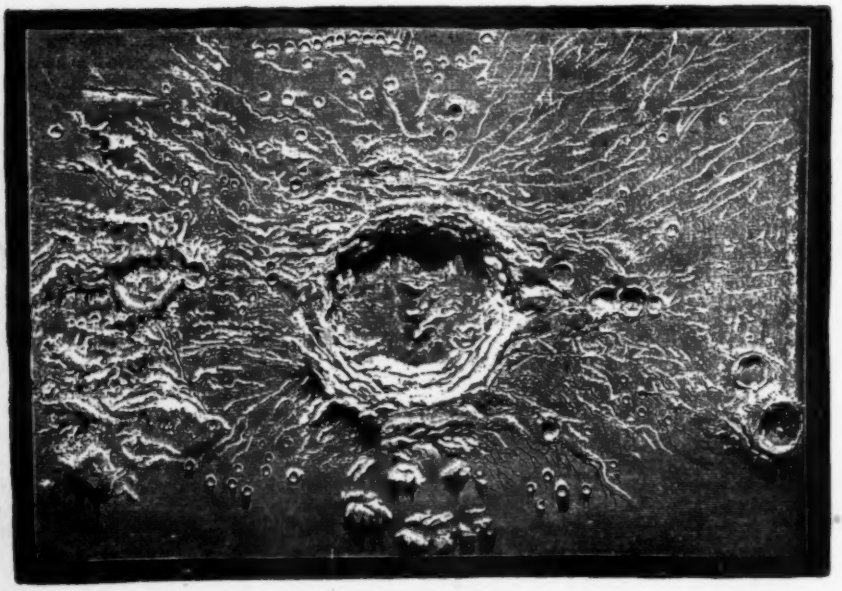

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